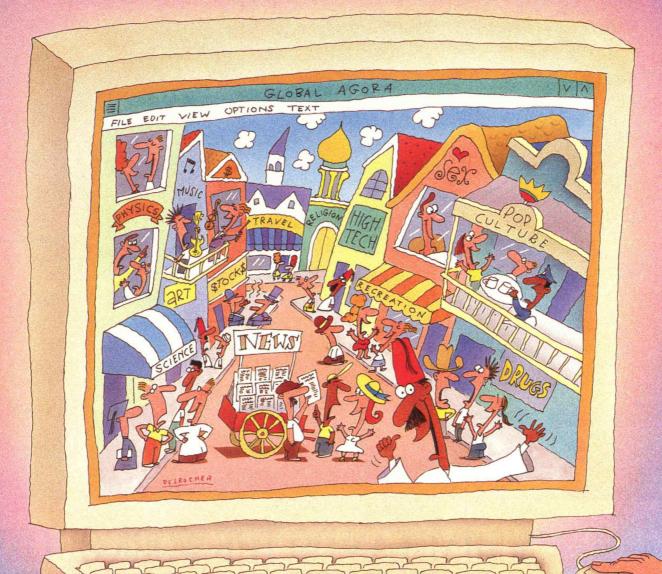


Life on the Net chaos and community on-line



ALSO IN THIS ISSUE:

- **♦ WHY DEFENSE CONVERSION WON'T WORK ♦**
- ◆ THE SECRETS OF SILICON VALLEY'S COMEBACK ◆
- ◆ BUILDING THE MACHINE THAT TOOK US TO THE MOON ◆
- ORDER WITHOUT LEADERS: THE POWER OF DECENTRALIZED THINKING *

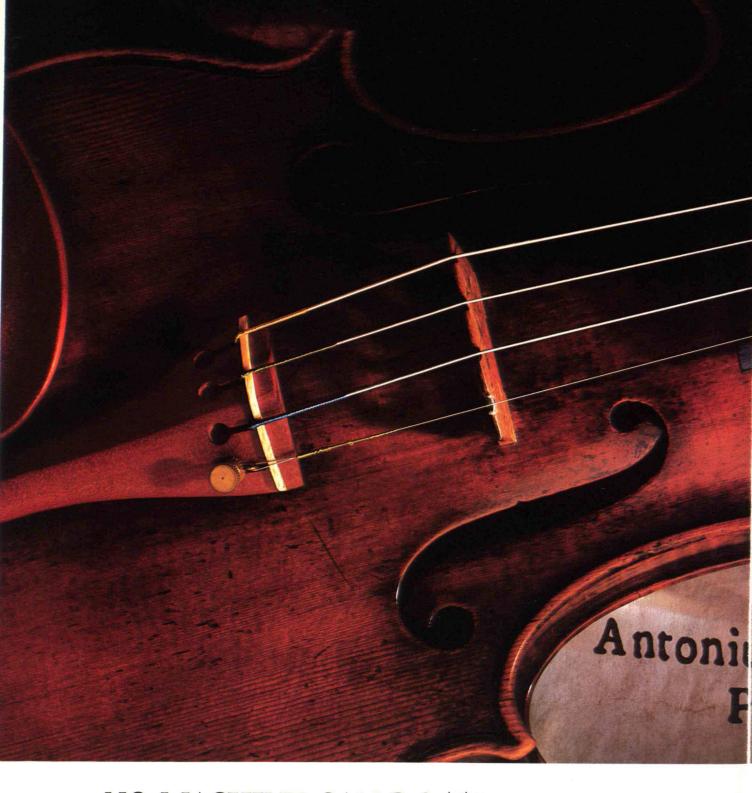
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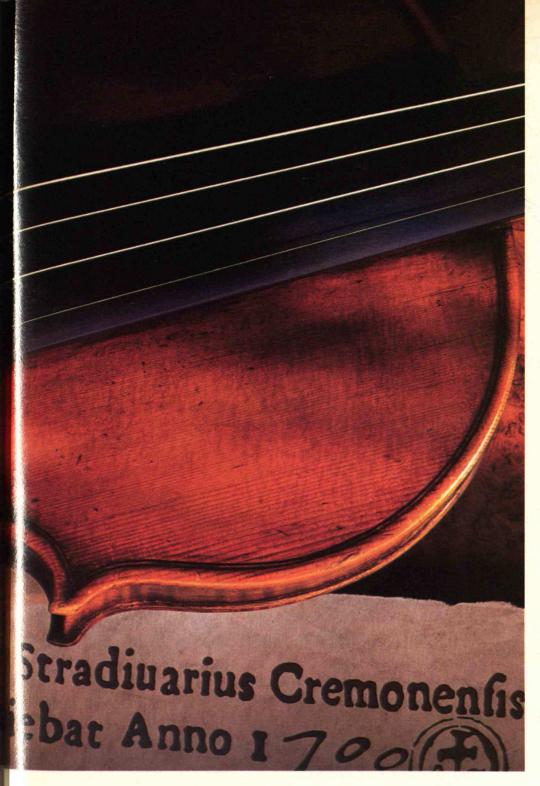


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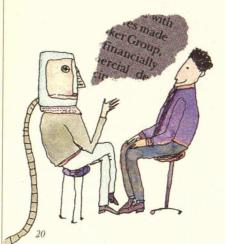
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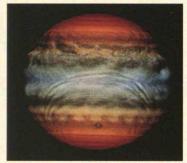


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FirstLine

Turning Missiles into Chevrolets

In the first few days of my first engineering job out of college, at an aerospace firm near the Boston area's Route 128, my boss sat me down with a bunch of Air Force manuals so I could begin learning the jargon and culture. But while I soon realized that our project's technical aspects would provide interesting challenges, I also started worrying about what it all meant. Sanitized terms like "close air support," "air interdiction," and "counterair," for example, essentially referred to engineered destruction and death.

Why not apply the firm's resources, I thought, to uses that *enhance* life instead of compromise or destroy it? I was naive enough to say so to the department head—my boss's boss—when he dropped in to see how I was doing. "This warlike stuff really bothers me," I told him. He chewed on his pipe, deep in thought, for what felt like an hour, and just when I concluded he'd soon be showing me the door he answered: "It really bothers me, too. But I've been in this business all my life, and it's all I know."

In this post–Cold War era, "conversion" of aerospace firms is finally one of our country's major goals—and many in the defense industry are now trying to apply "all they know" to the direct civilian/commercial good of the nation. But it clearly won't be easy.

For one thing, companies don't readily switch fields or working styles. For another, while some military products may conceivably be "dual use" or yield spinoff, others defy such fortuitous revival. "There are some things you cannot convert," said Dennis J. Picard, CEO of Raytheon Co., at a seminar at MIT last fall. "It's very hard to convert a missile to domestic use."

Yet even missiles are being considered in our current attempt to wring broader benefit out of defense-oriented ventures. "Hoping to find a peaceful, commercial use for relics of the Cold War," a recent story in the *New York Times* began, "the White House is considering recycling dozens of nuclear-warhead missiles and selling them to American industry for launching commercial satellites."

But these missiles, while they might find niche applications in some fields of scientific research, were built to deliver relatively light payloads (massively destructive, but small), and to carry them only through low-earth orbit. Communications satellites—the main application of commercial launches—are typi-

Defense companies can indeed be converted, but mostly through reincarnation.

cally heavier and require placement in much higher orbits.

A bigger problem, however, is the cost and complexity of such products, built to exacting military standards. The missiles can in fact serve as a metaphor for the limited commercial prospects of the companies that make them. What complicates, even bedevils, these firms' conversion is the very set of powerful and refined capabilities that have long enabled them to provide yeoman's service to their customers at DOD and NASA.

"At first it might seem as though the same U.S. companies that built sophisticated guidance systems capable of sending a smart bomb through the air shaft of an Iraqi bunker could certainly retool and make consumer electronics to compete with NEC or Panasonic," says Bruce D. Berkowitz in "Why Defense Reinvestment Won't Work," in this issue. The problem, he maintains, "is management and organization. The specialized structure, procedures, and culture that defense contractors have developed over the past 40 years to survive in the defense economy make them hopelessly ill-suited for competing in commercial markets."

John M. Deutch, now deputy secre-

tary of defense, spoke in a similar vein in the April issue of *Technology Review*. "The defense procurement system," he said, "was designed for a different world—a world of large-scale systems and defense-unique items."

Though a few companies "might find useful commercial application for widgets built to military specifications," says Berkowitz, "these will likely be the exceptions." In an interview also in this issue, Joseph G. Gavin, Jr., former president of Grumman Aerospace Corp., agrees, noting that "the products of the 'converted' aerospace company need a top-of-the-line aura....When you're betting somebody's life on the outcome, you get into a methodology that is too expensive for commercial products—unless you want to create a Mercedes. You cannot compete by trying to produce a Chevrolet."

Gavin maintains that "people who say 'convert the defense industry' don't really understand what they're proposing: it's more accurate to say that there's much there that can be directed to some useful commercial purpose." But in many cases, Berkowitz and other analysts argue, we should cut to the chase. "Instead of attempting to prop up defense firms that are no longer needed," he says, "it would be more efficient—and, in the long run, more humane—to let them die a natural death."

Those aerospace firms that remain will likely continue to play a major role in maintaining the nation's defense and its powerful, though reduced, defense industrial base. In some cases, modest adaptations will enable them to serve specific Mercedes-like commercial functions. But the true "recycling" of whole companies, in the usual sense of reclaiming the essence, say, of used aluminum and paper products, will require decomposition and reconstitution. The country's awesome engineering talent previously constrained by defense needs and procedures may thereby be unleashed with a vengeance, in the form of new or enhanced commercial enterprises.

-STEVEN J. MARCUS

TechnologyReview

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Letters

A NEW DAY AT DOD

In "Reforming the Pentagon: An Inside Job" (TR April 1994), John M. Deutch provides insightful comments on the changes occurring within the Pentagon and the defense industry. More important, he is in a position to do something about it. If the Pentagon can overhaul its



cumbersome, overregulated, and costly procurement system to allow nondefense companies like Motorola to sell their products to the government, that will also help companies like the one I serve, Martin Marietta, to integrate commercial products into the many defense systems we produce.

I would make a plea to halt the turbulence in the acquisition process. The principle cause of its inefficiency is the perpetual motion of requirements, people, scheduling and funding. Each funding cycle does not start until the slate is wiped clean from the previous year and new priorities are set. What is needed is common agreement—in Congress and the executive branch—on mechanisms that make it harder to start new programs, that authorize only a few people to change a program once it is started, and that establish multivear budgets for the Pentagon and its programs. In other words, the time has come to appropriate funds by project, not by the year. Many of us in the industry are encouraged that the Pentagon is facing up to the need for a thorough overhaul of its procurement process.

Finally, I would note that Deutch is also right on the mark in discussing the need to downsize government-run defense facilities to balance the downsizing taking place in the private sector and take advantage of the inherent flexibility of contractor-operated labs and industry R&D. As he correctly states, today's defense infrastructure was largely designed to deal with yesterday's military problems. We are now in a different world, one that requires innovation and change.

If fundamental cultural change starts with leadership at the top, the Pentagon is well served in having the services of John Deutch and Defense Secretary William Perry.

> NORMAN R. AUGUSTINE Chairman and CEO Martin Marietta Corp. Bethesda, Md.

UNFAIR R&D COMPETITION

In "A Strategy for the National Labs" (TR February/March 1994), Robert M. White suggests that DOE laboratories be subsidized while they attempt to penetrate the private-sector contract R&D business. How fair is such a strategy to existing contract R&D organizations, which include large institutions such as Battelle, SRI International, SAIC, and Southwest Research Institute as well as hundreds of smaller corporations, including mine? All these organizations, both for-profit and notfor-profit, have gradually built their capabilities by investing capital and earnings in laboratories, instruments, computing facilities, and staff. It seems to me that if federal laboratories have outlasted their mission, they should be closed—not subsidized in the hope they will take R&D business away from existing institutions.

> CHARLES E. KOLB President, Aerodyne Research Billerica, Mass.

HIGH COST OF SOFTWARE

In a letter to the editor (TR February/ March 1994) that appeared in response to "Subduing Software Pirates" (TR October 1993), A. Kerim Kar maintains that U.S. software companies should cut the high costs of programs sold in developing countries. This situation applies equally well to developed countries in

Europe, where U.S.-originated program packages sell for double to triple their neighborhood-software-shop prices in the United States. When I ask distributors here in Belgium about the price differences, the answer is always: they are needed because of the copying. (High European prices cannot be explained by the cost of intermediaries or local taxes, since the European offices of U.S. firms offer upgrades at multiples of prices I'm offered for the same software in ads mailed to my address in the United States.) The European office of a U.S. firm told me that "we pay more to our U.S. parent for upgrade kits than



its retail price in the U.S." Ironically, the result is rampant copying through "rental clubs," less formal trading among friends, plus institutionalized violations by even large companies.

U.S. software houses are injuring themselves (and the U.S. balance of payments)

by their wildly high pricing.

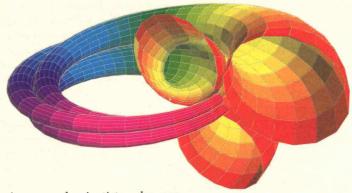
Unlike Kar, I don't think U.S. software should sell below its actual (not list) U.S. price; there are antidumping laws here, too. Just realistic pricing would cause a sales boom and reduce copying, both casual and institutional, to "reasonable" levels. Most people would prefer to obtain the manufacturer's package that includes the manyhundred-page users' manual rather than stand at a photocopying machine.

> LESTER A. GIMPELSON Brussels, Belgium

CORRECTION

"Simulations on Trial," in the May/June 1994 issue, reported that Honeywell hired computer animators at Forensic Technologies, Inc. (FTI), to help prove that Minolta infringed on Honeywell's patented autofocus camera technology. The article also said Minolta hired FTI's rival, Z-Axis. Actually, the reverse is true: Honeywell hired Z-Axis and Minolta hired FTI.

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TREATING THE WHOLE PATIENT

My experience attending medical school and working in the health-care field is vastly different from that portrayed by Adriane Fugh-Berman in "Training Doctors to Care for Women" (TR February/March 1994). At my alma mater, the University of Kentucky, breasts were studied in anatomy, female orgasm was recognized, patients were informed of the potentially upsetting nature of their sexually transmitted diseases, and female medical students did examine male patients' prostates. Furthermore, during my residency in family practice, doctors delivered fewer than 15 percent of their patients' babies surgically—nowhere near the 50 percent the author cites. Of the women I followed personally from beginning to end of pregnancy, none went to Caesarean

section, and less than 15 percent required (or received) episiotomies.

I also take issue with the author's use of inflammatory language, such as when she labels as a "misguided study" the experimental use of estrogens in men for possible cardiovascular benefits. The study was

not misguided, simply negative in its results. In science, we do studies because we do not know all the answers or potential outcomes. At least the researchers did not falsify positive data to "get published" at the expense of progress.

If we want to create yet another branch of medicine, perhaps a specialty in men's health could reduce the current disparity in men's life expectancies. This would do much to alleviate the suffering and loneliness at the end of many women's lives. But what we really need are more good family doctors.

BRUCE KINZINGER, MD Joppatowne, Md

Adriane Fugh-Berman overlooks the fact that the specialty of family medicine provides comprehensive care for women. A residency-trained, boardcertified family physician will spend three years in postgraduate training that includes work in internal medicine, surgery, obstetrics, gynecology, orthopedics, pediatrics, emergency medicine, geriatrics, behavioral medicine, and other subspecialty areas. Residency programs are also incorporating a curriculum of women's health into those three years of training.

Is there room for improvement? Always. Do we need another specialty? I believe we should perfect what already exists.

SUSAN Y. MELVIN, DO Associate Clinical Professor of Family Medicine University of California, Irvine

Fugh-Berman's view of women's health care continues the separation of men and women into opposing camps

> that regard each other with distrust and some hostility. The author's medicalschool experience was unfortunate, but even with that dismal start she was able to rise above it and view women with respect. The goals she promotes have been incorporated into graduate medical programs in obstetrics

and gynecology. Many men, including myself, embrace these ideals within this specialty. We don't need more division; we need caring physicians who treat patients with respect and as partners in their health care.

> H. J. NUSBAUM, MD, PHD Albany, N.Y.

A GRAND DESIGNER?

Thank you for publishing Kenneth Miller's balanced review of the latest creation/evolution controversy ("Life's Grand Design," TR February/March 1994). People on both sides of the debate too often take non-negotiable positions and either misrepresent science or twist Biblical scripture.

Using evolutionary theory to explain biological change over time does not contradict the Bible. According to the Big Bang theory, all matter in the universe, as well as space and time, began with a single spontaneous flash of creation that evolved in stages until the present. The first chapter of Genesis agrees. Whether these events occurred over one week is debatable. Time is relative to the observer on a cosmic scale, and the Bible clearly states that God exists outside human time.

By trying to sway public education through expensive legal tactics instead of genuine debate, the creationists fail both science education and Christian education.

> Tom Morrow St. Petersburg, Fla.

Scientists and educators are greatly indebted to Kenneth Miller for his energetic and effective defense of evolution against creationist attacks during the past decade.

The "intelligent design" (ID) thesis does have some advantages. One of the irritating features of the 1980s debates was the refusal of creationists to commit themselves to any specific hypothesis that could be analyzed and tested. But as Miller shows, ID does allow such analysis and testing; his discussion also shows clearly what Darwinian theory assumes and what it rejects. Thus, in a classroom free of outside pressures, there might even be some pedagogical value in presenting ID when teaching evolution. College biology teachers should also consider using Miller's article in courses for mature students who know enough about science to follow the argument. And all science teachers could profit by reading the article to understand the issue.

But we must resist attempts to inject ID as an alternative to evolution in public-school pre-college science classes. Unfortunately, teachers face tremendous pressure to avoid trouble by opting to teach neither. That's just what fundamentalists want—getting evolution out of the schools is better for them than having their own flimsy alternative presented by skeptical teachers.

STEPHEN G. BRUSH Professor of History of Science, University of Maryland College Park, Md. Kenneth Miller maintains that life evolved in the absence of any design, but his arguments do his thesis a disservice. As anyone who has worked on a complex software system that has evolved over a period of time can testify, good programs are full of flawed, nonoptimal, and nonfunctional components similar to the biological design flaws that Miller describes. These flaws are the natural result of the evolutionary nature of the design, limited resources, and human imperfection. Still, such programs, although flawed, are clearly the work of intelligent designers. I maintain that DNA with its inactive and pseudo-genes does in fact very much resemble a complex computer program. I have no intention of arguing in favor of those who oppose the teaching of evolution science in our schools, but I do believe that Miller's argument would be better used to support the notion of a nonomniscient master designer or a group of designers working in an evolutionary manner.

JOHN SILLETTO Somerville, Mass.

ART IN OLD TECHNOLOGY

It is unlikely that the man appearing in Vincenzo Pietropaolo's photograph in "Encountering the Machine" (TR February/March 1993) is actually carrying a "gear." Such an item would weigh at least 200 pounds. He is probably carrying a gear pattern—a precisely crafted hardwood replica of a gear used in machining metal patterns for foundry molds or in preparing sand molds for casting in iron. Many old foundry patterns have become available for decorative or other uses with the closing of foundries and passing of this technology.

ROBERT M. PARK Detroit, Mich.

Editor's note: In making the same assertion, astute reader Charles E. Woods of San Antonio writes about the "gear": "The hole for the shaft has not yet been bored, nor the keyway broached—further evidence that it is likely just a pattern."

Continued on page 78

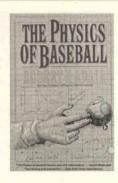
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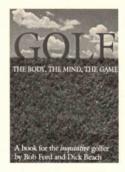
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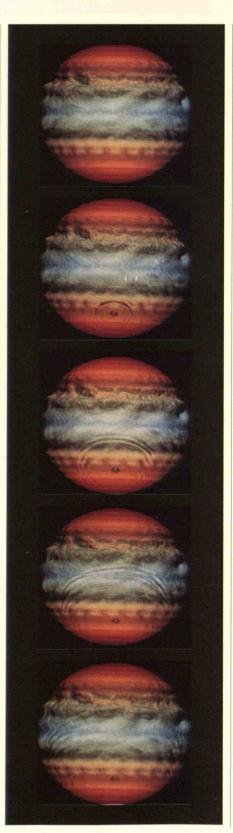
MODELING BIG HITS

Between July 18 and 24, an unevenly spaced string of fragments of the comet Shoemaker-Levy 9, which astronomers believe shattered in 1992. should take their turn smacking into the gaseous planet Jupiter. The event will not only mark the first occasion for astronomers to observe the impact of comet leftovers that have struck a planet. It also could help them substantially improve their models of the lower atmosphere of the solar system's largest planet. That information, in turn, could improve understanding of large features in our own atmosphere, such as the occasional eddies known as "blocking

highs." Timothy Dowling, an assistant professor in the Department of Earth, Atmospheric, and Planetary Sciences, developed a time-lapse, computergraphic simulation of Jupiter's atmosphere in 1989 while a PhD candidate at the California Institute of Technology. His original intent was to determine the dynamics of Jovian jet streams and eddies-in particular the Great Red Spot, a reddish-orange eddy that astronomers have watched for three centuries. Now Dowling and MIT graduate students Joseph Harrington and Raymond LeBeau and undergraduate Kari Backes have added to the model a single planetary "strike" of a fragment one kilometer wide. (Although the sizes of Shoemaker-Levy's fragments are hard to determine because of their distance from earth, all of them appear to be less than four kilometers across.)

The researchers have placed the simulated strike at about 37 degrees below Jupiter's equator, where the actual hits are predicted. As the fragment hits the clouds of Jupiter's upper atmosphere, it creates huge waves moving away from the center, resembling, says Dowling, "ripples formed by dropping a rock in a pond."

The speed of the ripples relates to changes in Jupiter's gas density at different depths, information critical to understanding the structure of the planet's tro-



posphere, or lower atmospheric layer. For Dowling's model, and for at least four simulations developed elsewhere. scientists have only been able to guess at the changes. The MIT scientists' latest model, for instance, relies partly on theoretical extrapolations by researchers concerning the planet's lower cloud layers. And although it incorporates data on Jupiter's horizontal winds at the top of the atmosphere, plus vertical temperatures and pressures—the Voyager 1 and 2 spacecraft gathered that information when they flew by Jupiter in 1979—"we've been doing mathematical calisthenics," Dowling says.

But now, he adds, "we have a natural experiment to do the job for us." The striking of comet fragments in July, to be observed by the Hubble Space Telescope and earthbound telescopes that can "see" visible or thermal-infrared light, should reveal the accuracy of how the simulated ripples form and at what speed they spread. Dowling explains that the speeds of the waves will depend on how deeply the fragments enter the atmosphere.

The final result—a clearer picture of Jupiter's atmospheric stratification—should enable scientists to better comprehend phenomena such as Jupiter's eddies. And that might help researchers fill in knowledge gaps concerning the formation and behavior of huge eddies that persist for long periods of time in earth's atmosphere and ocean. The earth's atmospheric eddies, which can last for months, include blocking highs such as the high-pressure system that halted normal rainstorm paths and thus exacerbated the 1988 drought across the United States. Ocean eddies, which

In a simulation, a comet fragment striking Jupiter (second image from the top) produces expanding waves in the planet's atmosphere over the course of four days. By comparing the model with observations of real fragment strikes in July from the comet Shoemaker-Levy 9, researchers should learn more about the planet's atmospheric structure, and hence about climatic conditions on earth.

MIT REPORTER

can cause heat fluctuations in the water that affect climate, include the Gulf Stream Rings, found along the Gulf Stream east of the Carolinas, and the "Meddies" that form where the Mediterranean and Atlantic waters meet. Surprisingly, there is little information about such eddy patterns.

-PATRICIA BARNES-SVARNEY

DISCOVERING HOW CELLS DIE—AND PEOPLE SURVIVE

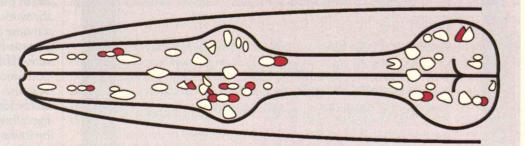
For a human being to live, millions of its cells must die, never to be renewed. Early in life bone marrow churns out millions of different candidate immune cells, for example. Yet before they can be accepted into the immune system, these cells must pass

Gehrig's disease, and in stroke, biological mechanisms cause cells to die," Horvitz says. The question is whether these mechanisms involve proteins corresponding to cell-death genes.

For 20 years, Horvitz has studied cell death in a tiny soil nematode called Caenorhabditis elegans. While this worm might seem to have precious little in common with a human being, Horvitz has gambled that the cell-death mechanism might be so basic that it would turn out to be similar in both species because evolution would have largely preserved it. He reasoned that the nematode would be ideally suited for cell-death research because his team had found earlier that each immature worm generates exactly 1,090 cells, of which 131 die during the animal's development. He figured that, if in the developcell-death work on nematodes by exposing adult worms to chemicals that cause genetic mutations in their sperm and eggs. Some of the mutant offspring, in turn, showed aberrations from the normal cell-death pattern. That allowed his team and other researchers, over the course of 10 years, to identify 14 so-called ced genes (named for *Caenorhabditis elegans* death) that exist in the nematodes.

For example, Horvitz and Hengartner found one gene, ced-9, whose protein actually keeps the cell-death process in check. They discovered its role by examining nematodes in which cells destined to die instead stayed alive, yielding creatures with extra growths. In other worms, certain cells died that in normal animals lived. The researchers believed that both cases could be explained by

Cell nuclei marked in red in the worm Caenorhabditis elegans indicate cells that would have died in an early developmental stage if not for the existence of altered "cell-death genes." Such genes could play a role in several diseases.



through the thymus, which weeds out those that might assault the body's own tissues.

Massive casualties such as these are perfectly normal—in fact, necessary. If this process, known as "programmed cell death," goes awry, it can be dangerous, says H. Robert Horvitz, a professor of biology at MIT. When defective, the genes that direct the process likely play a role in several diseases. Should the genes, through the actions of the proteins they encode, obstruct the death of certain cells, lymphoma or possibly autoimmune diseases such as diabetes and rheumatoid arthritis may result. Cell-death genes may also prove to be a culprit in the premature demise of normally long-lived nerve cells. "In Alzheimer's, Huntington's, and Lou mental stage an incorrect number of cells died, abnormalities in programmed cell death would be at fault.

Horvitz's strategy is paying off. His group has discovered that the worm cells don't just fade away; more than a dozen genes direct an intricately choreographed suicide process. And in the past year, Horvitz and his coworkers have reported in the research journal Cell that two of the nematode's cell-death genes are similar to two mammalian genes, including one that in a defective form is associated with lymphoma. Such relationships verify that "the worm is a good model" for humans, says Michael Hengartner, a former graduate student of Horvitz and now a staff investigator at Cold Spring Harbor Laboratory.

Horvitz and his coworkers started the

defective versions of a gene that normally suppresses the cell-death pathway. In the first set of worms, ced-9 was abnormally active; in the second set, this genetic switch was turned off.

Next Hengartner found out where the ced-9 gene resides on the worm's chromosomes by first identifying certain "markers"—DNA stretches—often inherited with the extra growths, and then applying standard statistical tools that link markers and genes to determine genes' locations. He then sequenced the gene—identified the order of its basic chemical components—by relying on a common technique in which fragments of different lengths of a gene are run through a molecular sieve. The results are presented in a way that researchers can read the sequence of the gene's chemicals.

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Then Hengartner searched in an electronic database of all known genes for a sequence resembling that of the nematode gene. That effort turned up bcl-2, a human gene that independent studies had shown to be abnormally active in cancerous cells of 85 percent of all patients with follicular lymphoma, an immune-system cancer that strikes 25,000 Americans annually. Just how bcl-2's protein prevents the demise of cells that should die and hence contributes to cancer remains unknown.

This past year Horvitz and former postdoctoral fellow Junving Yuan, a molecular biologist and assistant professor at Harvard Medical School, also found that the protein corresponding to ced-3, which induces programmed cell death, has an equivalent in humans. That protein was already known but not previously implicated in the celldeath process. The researchers carried the work a step further by showing that a mouse analogue of ced-3 triggered the expiration of mammalian cells in culture. (This work was important because both mice and humans are mammals.) Scientists can now search for drugs that will block the human protein from causing cells to die prematurely. Conversely, by finding a drug that mimics the protein they might be able to treat diseases that stem from too little cell death, such

Research on programmed cell death has sparked interest in the pharmaceutical and biotech industries. Indeed, three companies hoping to exploit the genetics of programmed cell death have sprung up in the past two years. No one expects new drugs any time soon, since finding compounds that could target or imitate the proteins, and testing to ensure that there are no serious side effects, are not simple tasks. But given growing interest in the field and the recent successes, researchers expect to identify over the next few years more cell-death nematode genes with human correlates, making more likely the unravelling of the entire interplay of proteins that decide the fate of human cells.

—GABRIELLE STROBEL

Trends

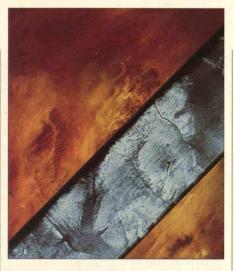
Space-Age Divining Rods

Egypt's Western Desert is one of the most desolate places on earth: more than half a million square kilometers of scorched, unbroken sand where not a drop of rain may fall in 50 years or more. Yet radar on board the space shuttle not only pulled back the veil covering this vast wasteland to reveal that it once teemed with life, but is now helping it do so again.

During the first exploration of the desert by westerners in the 1930s, British Army officer Ralph Bagnold ventured beyond "the last bone of man or of mouse; in places where nothing exists, no sprouting blade of grass nor worm of decay; where perhaps, in certain spots, nothing ever did exist." Following in Bagnold's steps in the mid-1970s, Farouk El-Baz, a geologist and native Egyptian seeking to find out how this unforgiving desert formed and changed over time, found similar desolation as well as a seeming incongruity.

The outlying areas of the desert revealed water-smoothed gravel terraces and human artifacts, El-Baz says, suggesting the region once bore rivers as well as inhabitants. But in the desert's core area along the Sudanese border, El-Baz came upon what looked like an enormous lake of sand with not the slightest sign of life. Conventional satellite photos revealed as little as the naked eye.

El-Baz, then research director at the U.S. National Air and Space Museum at the Smithsonian Institution, turned to Charles Elachi of the Jet Propulsion Laboratory to help solve the puzzle. Elachi had developed an instrument known as the Shuttle Imaging Radar (SIR), which bounces radar waves off solid rock or water on earth. The rockier the terrainand the denser the moisture—the brighter the "radar echo." "When you put all the bits and pieces of incoming data together, you make something like a photograph," says El-Baz, now director of the Boston University Center for Remote Sensing.



The space shuttle's radar imaging system penetrated a strip of Egypt's Western Desert to show that a vast river system once flowed in an area now covered by 5 meters of sand. The radar data led geologists to explore the underlying bedrock, where they found enough water trapped in aquifers to support agriculture in the region for 200 years.

When asked to survey Egypt's Western Desert, Elachi was skeptical that the SIR would reveal much of anything. But he agreed to procure a strip of images of the southernmost portion during a shuttle flight in November 1981.

El-Baz was as astonished as Elachi when the images came back: the radar had penetrated several meters of sand (apparently because of the sand's porosity and utter lack of moisture) and exposed the courses of three long-stilled rivers and their tributaries. One of the rivers was as wide as the entire Nile Valley—clearly, the waterless land once boasted one of the world's great river systems, with all the attendant life that thrives along major waterways.

The news spread quickly. In 1982, Egyptian and U.S. geologists and archeologists set off into the desert to find the general area shown in the radar images. They quickly proved through actual excavation that the embankments and silt-laden river bottoms shown on the radar printouts were really there, just five meters below the surface.

They also discovered by carbon dating rock samples that the riverbanks

probably formed 200,000 years ago, when the rivers gushed at peak flow. The teams further unearthed hand axes and other evidence suggesting that Stone Age hunters inhabited the region as recently as 5,000 years ago, before a changing climate desiccated the area.

Yet a discovery of even greater practical significance remained. Since water in lakes and streams tends to seep into underlying bedrock to be stored in aquifers, El-Baz realized this so-called "hyperarid" region might harbor fossil water. He convinced the Egyptian government to drill about a dozen wells near the confluences of several of the former rivers. There, beneath a region capable of evaporating 200 times the moisture it receives, each well brought forth fresh, clear water from depths of 100 meters or less

Today, in the heart of the great sand lake that El-Baz discovered, an experimental farm abounds with potatoes, corn, tomatoes, and wheat. Called East Uweinat after the nearest mountain, the farm covers some 21 square kilometers and is eventually expected to extend to more than 84 square kilometers.

The imaged area appears to have been near the edge of an ancient lake, El-Baz says, so reclamation experts established the farm closer to the old lake's center, where the greatest concentration of water would mostly likely be found, and set up a system of water pumps and irrigation channels to flood the crops. Geologists estimate that the reservoir can support agriculture for 200 years.

Other uses of earth-imaging radar may prove equally valuable. By studying patterns of rock formations and subsurface crevices and pockets, geologists hope to glean the whereabouts of other underground resources, such as oil and gas. The radar can penetrate rainforest cover to help geologists map the underlying terrain. And in any weather conditions, day or night, it can be used to help guide ships around hazardous icebergs and through elusive channels in pack ice.

Finally, SIR can pinpoint likely sites for archeologists to probe. For example, when viewing a set of images of the southern Arabian Peninsula, Elachi saw a series of lines leading to a single point. "Archeologists went to this area in Oman and found that these lines are really ancient roads, says El-Baz. "The point where they meet is the site of an ancient city," which may be the lost city of Ubar, famous in the Koran and other literature as a major stop on the frankincense trade route. Further investigations using SIR images and satellite photos led to the discovery of another, even larger ancient entrepôt, Saffara Metropolis, in Oman's Qara Mountains.

Elachi's latest brainchild, a technologically advanced SIR, flew in April on the shuttle Endeavor and is scheduled to fly again in August. Part of the \$366 million, 23,000-pound Space Radar Laboratory, the new SIR is regarded as the most sophisticated radar system ever used in space. Unlike its single-wavelength predecessors, which sent C-band (6-centimeter) signals, the new model also uses X-band (3-centimeter) and Lband (23-centimeter) wavelengths. Each wavelength penetrates surface materials differently. L-band radar penetrates solid ground better than shorter wavelength signals do, and X-band signals reflect better off of low-density materials. Combining data from the three frequencies produces sharper images than were previously possible.

The radar images from the April shuttle flight will be used to study the geology and hydrology of nearly 20 sites in South America, Australia, Egypt, the Sahara Desert, and Death Valley, Calif. El-Baz has requested radar strips of two areas—the Arabian Peninsula, where he has been working since 1991 to evaluate the Gulf War's environmental effects; and Egypt's Western Desert, where he hopes to further trace the rivers uncovered by the first SIR flight. He has also found evidence that other portions of the Sahara may conceal huge underground aquifers. He believes they may be on the scale of the one Libya is now tapping, which hydrologists claim will supply that riverless country with six million cubic meters of water daily for the next half-century.—PETER TYSON



Have Antimatter, Will Travel

Antimatter may be most familiar as the strange fuel that powers *Star Trek's* starship Enterprise across the galaxy in the twenty-fourth century. But the material is quite real. In fact, twentieth-century physicists are heralding it as a potential tool for accomplishing feats ranging from understanding the fundamental nature of matter to creating a powerful new form of energy.

Unfortunately, antimatter is also quite rare and volatile, which has severely limited scientists' ability to use the exotic material. For the past 40 years, physicists have been able to study particles of it as it zips around the massive linear accelerators where it is created by highenergy particle collisions. And because antimatter possesses an electrical charge opposite that of normal matter, a proton with a positive charge and an antiproton with a negative charge will annihilate each other on contact, converting all of

their combined mass into a flash of energy.

In recent months, however, researchers have developed a technique that collects more than a million antimatter particles at a time—an order-of-magnitude increase over earlier efforts. Encouraged by the ability to amass such quantities, they are designing cases for transporting the particles from the giant accelerators to their own labs for experimentation.

The technique represents a major step beyond the original technique for collecting antimatter particles developed by Gerald Gabrielse, a physicist at Harvard University. While working at the European Organization for Nuclear Research (CERN) in France a few years ago, he devised a way to siphon off as many as 100,000 antiprotons into a foot-long cylindrical trap. The billions of antiprotons created in the particle accelerator were first slowed from near light-speed by radio waves, which absorbed some of the antimatter's kinetic energy. This material was then guided by a magnetic

field into a separate tunnel at CERN, called the Low-Energy Antiproton Ring. Gabrielse took the small fraction of whizzing antimatter particles that would escape through an opening in the ring and confined them with a strong magnetic field in a vacuum tube.

In recent months, a team from Los Alamos National Laboratory led by physicist Michael Holzsheiter improved Gabrielse's technique by building a magnetic trap large enough to hold a million antiprotons. The team also fired electrons into the trap to slow the still whizzing particles, making them easier to use in experiments. Because the electrons also have a negative electrical charge, they absorb and dissipate the antiprotons' high energy without colliding with and annihilating them.

Using this concept, scientists at Los Alamos and Pennsylvania State University are planning to build portable antimatter carrying cases. An entire apparatus—which would require powerful batteries to generate the required magnetic fields—might be the size of a 40-gallon trash can and weigh 400 pounds. Though cumbersome, the cases would allow researchers to transport antimatter from CERN anywhere in the world, says Gerald Smith, a physicist at Penn State.

In one of the first experiments with such relatively large quantities of antimatter, theorists want to probe the accuracy of Einstein's theory of gravity. Michael Nieto, a theoretical physicist at Los Alamos, plans to open the end of a capture tube and drop antiprotons into another vacuum tube to measure whether gravity affects their movement any differently than it does normal protons under identical conditions.

If antiprotons fall at a different rate than protons, it would mean gravity is more complicated than even Einstein thought, perhaps involving an unknown force. Such a result could explain why theorists have had great difficulty uniting the theories of gravity, electromagnetic forces, and strong and weak nuclear forces to form a grand theory describing all the interactions of matter and energy in the universe.

Some researchers also think portable antimatter has a future in cancer therapy. Antiprotons aimed at tumors could be more effective at killing cells than standard radiation, says Theodore Kalogeropoulos, a physicist at Syracuse University. That's because antiproton beams, which completely annihilate the non-antimatter tissue on contact, are more destructive than the proton beams used in conventional therapy. He is planning an experiment at Brookhaven National Laboratory to shoot antiproton beams into a number of materials of varying density to test their precision and effectiveness.

In industry, antimatter might supplement x-rays as a more sensitive test

for detecting flaws or impurities in fabricated materials, such as panels for airplanes or a space station, says Terrence Goldman, a physicist at Los Alamos. Because the radiation emitted from antimatter annihila-

tions scatters much less as it leaves a material than x-rays do, antimatter scans may yield higher-resolution images revealing tinier flaws.

Stanley Bodsky, a physicist at Stanford University, and Penn State's Smith are part of a collaboration that has begun investigating the possibility of building entire antimatter atoms starting with the simplest, antihydrogen. Working at Fermi National Laboratory, they plan to mix individual antiprotons with antielectrons, or positrons, to form antihydrogen atoms.

Creating such antiatoms would be a key step toward what ultimately may be antimatter's most dramatic application: energy production. Remarkably, only a few cubic centimeters of antimatter, perhaps as a block of antihydrogen ice, would be required to propel a space ship, theorists believe. The ice could be bled to annihilate normal hydrogen atoms, generating billions of times the energy produced by burning the most efficient hydrocarbon-based fuels.

—DAVID GRAHAM

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A New King Cotton?

In 1793, Eli Whitney's patent for the cotton gin—a machine that separates cotton fiber from the seeds—revolutionized the textile industry, making cotton the most inexpensive and widely used fabric in the world. Now, U.S. Patent No. 5,159,135, granted at the end of 1992, promises another revolution in cotton growing that may extend far beyond the cotton fields.

gene-delivery systems that insert fragments of DNA into plant cells to alter traits of the plant and its progeny. The new patent covers the company's socalled "gene gun," which uses an electrical charge to blast minute metal particles coated with DNA directly into the cells of a cotton plant. But following in a tradition of affording broad rights to inventors in new areas, the patent also grants Agracetus the rights to all genetically engineered cotton products, pro-

decide not to license its patent and thus could prevent any given product from reaching the market.

In response to such concerns, Agracetus has pledged to offer licenses of its patented technology at no charge to publicly funded researchers working on genetically engineered cotton. But the picture is less clear regarding the commercial uses of such research. Recognizing the sensitivity of the situation, Russell Smestad, vice-president of Agracetus, says his firm will take great care to "manage the asset" bestowed by the patent. "We want to foster innovations," he says, "and we are open to relationships with others."

In fact, Agracetus has already licensed Monsanto and Calgene, two firms with long-standing cotton-engineering programs, to develop new products. For example, Calgene will conduct a large-scale field test in the United States of the world's first transgenic cotton product: an engineered cotton variety that can withstand greater concentrations of the herbicide bromoxynil. The new strain will purportedly allow farmers to choke out more weeds, thus increasing cotton yields without killing the crop itself.

But the licenses granted so far allow only for what Smestad calls the "agronomic" aspects of cotton—ways to boost yields or make the crop more resistant to pests or chemicals. Still uncertain is whether the company will license other firms to develop products that change the nature of the cotton fiber itself—a reported area of specialty for Agracetus. Smestad says only that Agracetus will review such proposals on a case-by-case basis. At stake, at least theoretically, is a major market for cotton with new properties such as superabsorbency, improved strength and durability, and wrinkle resistance.

The Agracetus patent will affect still other aspects of cotton research, such as attempts to improve the nutritional value of the plant's seeds. For example, cotton seeds are used as feedstock and to produce oil for human consumption, but they contain a natural poison called gossypol that must first be removed. Sev-



A controversial patent grants the biotechnology firm Agracetus rights to all genetically engineered cotton, such as this new variety featuring tear-resistant fiber.

Geneticists at other labs claim the broad ruling could hinder further research since royalties from sales of transgenic cotton products must now be paid to Agracetus.

While companies have long been granted patent protection for seed varieties, this patent is the first to cover all varieties of an entire crop that have been genetically engineered to contain traits from unrelated organisms. As such, it is widely believed to be the broadest patent ever granted in the field of plant biotechnology.

The patent was awarded to Agracetus, a Wisconsin-based biotechnology subsidiary of the giant chemical firm W.R. Grace. Formed in 1981, Agracetus is a leader in cotton-gene research and

duced by the gun or any other method, until 2008.

Not surprisingly, the patent has stirred significant controversy. The decision is "very unfortunate," says Jerry E. Quisenberry, director of the Cotton Systems Research Laboratory at the U.S. Department of Agriculture (USDA). "Rather than being able to release new genetically engineered cotton varieties directly to farmers, we are now forced to go to this large company and enter into an agreement with them," he says. In the end, he adds, Agracetus may

eral scientists, including a team at Texas A&M University, have been trying to engineer cotton whose seeds lack the poison. But some of the incentive driving such work may dwindle as royalties from the sale of new varieties go to Agracetus.

Challenging the Patent

Finally, the patent may influence the amount of research being conducted. Researchers at USDA and elsewhere have already noted that private funding has stalled as potential investors try to figure out how the patent could alter prospects for return on their investment.

Cotton growers will also feel the effects. John Barton, director of the Law and High Technology Program at Stanford Law School and a legal scholar specializing in patents, notes that farmers have historically reaped financial benefits from using patented seeds. Though the seeds cost more, the greater yields and higher quality more than offset the higher prices. Now, as companies need to recoup research costs enhanced by the Agracetus patent, the seeds might become prohibitively expensive.

After much grumbling in trade circles, the U.S. patent office has agreed to a formal reexamination of the patent on the basis that it may have overlooked other seminal work in the area. In an even more interesting twist, the USDA itself is readying a legal challenge against the Agracetus patent. Officials believe that the nature of the firm's invention does not justify the breadth of the patent and worry that "this type of protection could have an adverse impact on developing new types of genetically altered cotton varieties.'

Meanwhile, Agracetus is already seeking to extend patent protection for genetically altered cotton to the \$20 billion cotton market beyond U.S. borders. The firm has patents similar to the one granted in the United States pending in many of the other major cotton-growing regions of the world, including Europe, Brazil, China, and India.

–Seth Shulman



A Greener White House

Bill Clinton isn't content to leave the White House white. He has launched a project for "greening" his home and office by making it a model for energy efficiency and recycling.

By installing the latest technologies, he hopes to slash energy and water consumption by 30 percent. The Clintons see the project as "their legacy to the White House complex, as opposed to china or some other things," says Cathy Zoi, chief of staff of the White House Office of Environmental Policy.

The project is part of a larger effort to set an example for the nation. For example, Clinton has ordered federal agencies to purchase computers that meet a voluntary standard set by the Environmental Protection Agency last year for automatically cutting their consumption of electricity while lying idle. And in March, Clinton instructed agencies to designate at least one new federal building of every five as an environmental showcase, incorporating energy-efficient, solar-powered, or water-conserving technologies.

But giving the White House complex such a technological makeover is a much more demanding task than designing a "green" building from scratch, says William Browning, director of policy development at the Rocky Mountain Institute in Aspen, Colo., a research group that is advising the administration

By installing the latest "green" technologiessuch as energy-efficient appliances, insulated glass, and low-flow water devices—as well as collecting all recyclable materials, the Clintons bope to cut their energy and water consumption by 30 percent and make the White House a national environmental showcase.

on the project. Renovating the White House is all the more difficult because the 18-acre complex serves a variety of functions, serving as a landmark, museum, and popular tourist attraction as well as a home and office building.

The Clinton administration called on more than 100 experts from the Rocky Mountain Institute, the American Institute of Architects, and myriad federal agencies to scour the White House and draft a list of improvements. The suggestions-some 50 in all-had to be cost-effective in the long run.

Although obvious, the principle of cost-effectiveness was ignored the last time a resident of the White House tried to use new green technologies. Jimmy Carter insisted on installing a solar-powered water-heating system even though it cost more to operate than a conventional system.

The new plan calls for steps such as replacing incandescent lights with compact fluorescent bulbs, which cost more initially but pay for themselves by using 65 to 75 percent less electricity. The energy-efficient bulbs will replace electricity guzzlers in bathrooms, on office

desks, and even in the floodlamps that light up the facade of the White House at night. Planners expect each bulb to recoup its own cost after six months and save \$100 in electricity during its life-

As part of the present renovation of the Old Executive Office Building next door, which serves senior administration officials, workers will remove paint and grime from skylights originally intended to provide natural sunlight in stairwells.

The White House has also become the first recipient of a Golden Carrot superefficient refrigerator, built by Whirlpool in a \$30 million competition sponsored by electrical utilities last year. The unit uses a hydrofluorocarbon refrigerant instead of ozone-damaging chlorofluorocarbon compounds and consumes 30

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percent less electricity than previous refrigerators through design changes such as improved insulation and more efficient fans.

When Bill, Hillary, and Chelsea are done rummaging through their new fridge, the White House plan calls for them to sort and recycle their glass, plastic, newspaper, aluminum, and cardboard. "The First Family has received bins in their residence so they can do their own sorting," Zoi says. Similarly, guests at White House ceremonies will likely see recycling containers, she says, and will be asked to use them.

Other steps include installing thermostats on steam radiators, low-flow water-conserving sprinklers, and insulated glass in a solarium and greenhouse

in the president's residence.

The government has resolved to be more discerning in its purchases. Consider, for example, the 100 window air conditioners it buys each year to replace old or broken units in the Old Executive Office Building. The plan calls for the government to purchase more costly air conditioners with higher energy efficiencies that will pay for themselves with electrical savings in a year.

Glaring in its absence from the Clinton plan is any suggestion that workers should save energy by letting their offices get a little warmer during hot Washington summers or cooler during the winters. That contrasts with Carter's televised pleas one winter during his term when, wearing a cardigan sweater, he asked Americans to promote energy efficiency by bundling up and turning the thermostat down.

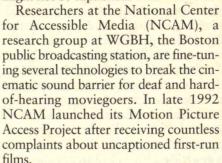
Carter's approach didn't work because people aren't willing to sacrifice comfort to save energy, the administration believes. Instead, the White House project focuses on using technologies that squeeze out energy savings while maintaining or even upgrading living and working conditions—such as by providing better lighting or eliminating the whine of an air conditioner. "This is about increasing comfort," Zoi says, "as we also save money and improve the environment,"-VINCENT KIERNAN

Reading the Silver Screen

A decade's worth of legwork and consciousness-raising sparked by deaf and hard-of-hearing viewers brought captioning to all genres of TV programming, from newscasts to music videos. The campaign has been so successful that, by law, decoders to translate closed-caption signals into words visible

onscreen are now built into all U.S. TV sets with screens at least 13 inches in diameter.

But if you have a hearing problem and want to watch the latest Hollywood film at your local cinema, you're out of luck. You're forced to wait for the home video to appear, and even then it might not be captioned.



The easiest solution would be open captioning, which all viewers would see. But conventional wisdom holds that hearing people resent captions. Witness the reluctance of major studios to release subtitled foreign-language films. Captioning for motion pictures has to be as unobtrusive for hearing moviegoers as it is useful for deaf and hard-of-hearing viewers.

Armed with a small grant from the Department of Education, NCAM engineers spent most of 1993 developing prototype movie-captioning systems. They faced a host of practical constraints, says Larry Goldberg, director of NCAM. First, because each device might be used by thousands of people, it would have to be all but unbreakable and impervious to what the rigorously scientific minds at NCAM call "cooties." It must also work virtually anywhere in an auditorium "so you wouldn't have to have a specialized deaf section in the theater," he explains. Finally, it must be readable, comfortable, easy to use, and above all, cheap enough that stingy theater owners

> would buy it and stickyfingered moviegoers wouldn't steal it.

> > A few months of brainstorming resulted in three trial technologies:

 Virtual Vision glasses: Initially developed as a kind of video Walkman for portable TVwatching, the Virtual Vision system

includes an oversized pair of eyeglasses and a small liquid crystal display that sits at the very top of the glasses and faces straight down. Captions are created by a computer and sent to the display through cables that tether the glasses to the seat. Through lenses and a mirror, the captions on the display are reflected onto the eyeglasses so that as the wearer looks at the movie screen, the captions seem to float in midair.

• A seatback display: This configuration consists of a vacuum-fluorescent display attached to the back of the seat in front of the viewer. The system—familiar from many supermarket cash registers—produces bright green dot-matrix characters that form the caption text by selectively energizing wires treated with a phosphor coating that glows when electrified. Users can adjust the height of the device as they would the head restraint in a car to place it within their visual range, thus avoiding hundreds of double-takes between movie screen and caption display.

• A rearview display: In this setup, a large light-emitting diode (LED) display located at the rear of the theater displays captions in mirror image. The user sees

the display reflected in a clear plexiglas panel mounted on an adjustable stalk attached to the arm of his or her seat while simultaneously watching the movie through the glass.

NCAM ran a field test of these technologies at a 65-seat Boston movie house showing *Sleepless in Seattle* and *In the Line of Fire* in October 1993. Audiences included hearing viewers as well as hard-of-hearing and deaf volunteers "because we wanted to see what hearing people would think if they were going to a theater with these devices around them," Goldberg says.

The systems received mixed reviews. When adjusted properly, the Virtual Vision glasses were highly readable and not distracting to other moviegoers. But the glasses need careful setup because they are designed to project virtual captions for a person's dominant eye. Thus, a person would have to know which eye

is dominant and request a left or right-eye version, and theater owners would need stocks of each on hand. Moreover, because the glasses are expensive (retailing for \$700 apiece) and contain high-tech c o m p o n e n t s, they're very much worth stealing.

Wearing the 5-ounce glasses through a twohour movie also took its toll in simple fatigue, particularly for people who already wear glasses. The cables were another annoyance.

The seatback display was bright and readable. But it blinked and flashed when the captions were changed, which distracted hearing viewers seated nearby.

The rearview display was dirt cheap, low-tech, and easy to use, but not as bright or readable as the other options.



It was also difficult to keep the plexiglas aimed at the LED display on the rear wall amid the jostling that occurs in a crowded theater. Still, Al Sonnenstrahl, a deaf person who tried each of the captioning systems, seemed most impressed with this option, finding it flexible enough to move to a comfortable viewing angle and both reflective enough to read the captions at the rear of the theater and transparent enough to see through the captions to the screen.

NCAM plans to conduct larger-scale tests on all three options in the next two years, says Goldberg, before deciding which one to release. In the meantime, researchers are working to improve the technologies. Adaptations to Virtual Vision glasses—such as reducing their weight and eliminating their

cables—are unlikely

given that they would involve sophisticated, and therefore prohibitively costly, components.

NCAM designers hope to make the seatback display less obtrusive by reducing its size, perhaps to the point of making it portable. They also plan to test a grooved coating for the screen that channels the image to a narrower viewing angle, limiting the sideways spill of light from the display.

For the rearview displays, designers hope to use a brighter LED display on the theater's rear wall. They also

want to use a stiffer gooseneck stalk to improve the display's stability.

—JOE CLARK



Novel devices that let deaf and hard-of-hearing viewers read captions in movie theaters include a plexiglas panel (top) that reflects captions shown in reverse on the back wall of the theater, a seat-back unit (left) that displays captions in dot-matrix characters, and special glasses (above) that project computer-generated captions onto the lenses.

Travels on the Net

THE COMMUNITIES THAT HAVE SPRUNG UP

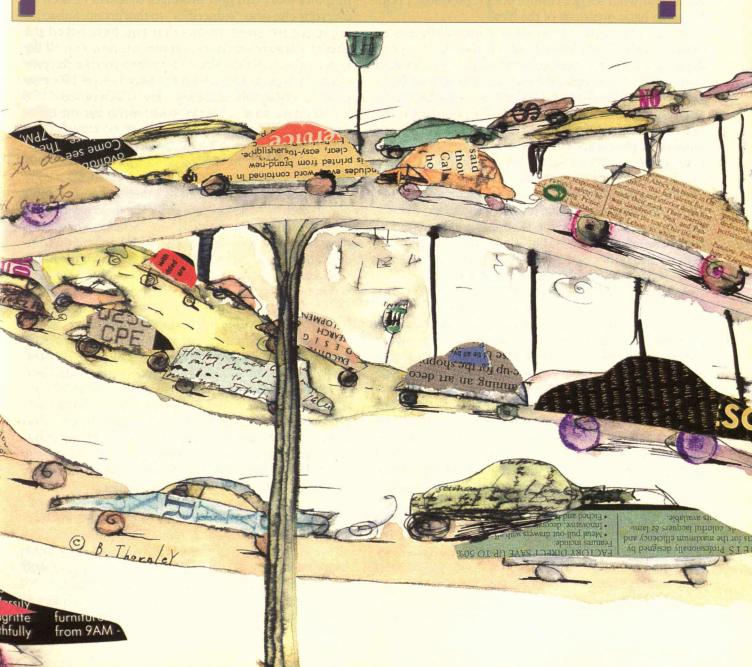
ALONG COMPUTER NETWORKS LIKE THE INTERNET ARE LIVING EXAMPLES OF
WHAT WORKS AND WHAT DOESN'T. PLANNERS OF AN INTERACTIVE
INFORMATION HIGHWAY, TAKE NOTE.

ILLUSTRATIONS BY BLAIR THORNLEY



BY STEPHEN STEINBERG

I discovered the Net my first year of junior high school. It seemed to me then that this vast, global web of computer networks offered a peek into the future. In the torrent of words and wisdom that pulsed through the Net every day I saw the raw and ungainly beginnings of a world with unlimited possibilities for learning, communication, and entertainment—a world that kept me from sleeping that night. Since then I have used the Net to aid me in my graduate research, as a communication tool at work, and as place to relax. It has become my library, my telephone, and my local cafe. As a member of the Net community, I have watched its exponential growth with mounting excitement and a growing conviction that the Net and its tech-



nological successors will fundamentally alter how we work and play. Corporations and policymakers are now clearly reaching a similar conclusion: that interactive media—in the form of the much-touted information highway—is crucial to our development as a nation.

There has been little discussion, however, of exactly how the new media will affect our society. This is frightening because new forms of communication have historically changed the social fabric in profound and nonobvious ways. The shift from an oral society to a literate one, for example, lead to a type of linear and abstract thinking that was previously unknown. Communications theorist Neil Postman has argued that the advent of television has shaped how we think by forcing our discourse to resemble entertainment. In his book *Amusing Ourselves to Death*, Postman posed three questions about television: What kinds of conversations does it permit? What are the intellectual tendencies it encourages? And what sort of culture does it produce? I pose the same basic questions of the Net.

At first glance the Net bears strikingly little resemblance to the 500 channels of television, video-ondemand, and home catalog shopping that has come to signify, for most people, the coming information highway. Unlike the video services that are being proposed and tested by telephone and cable-TV companies, the Net is a medium of text. And unlike the channel-zapping, multiple-choice controls that make these couchpotato services easy to use, the Net offers only an arcane interface of cryptic commands.

And yet the Net has the essential characteristics that allow for interactive media: it is as easy to transmit as it is to receive, and interaction is almost in real time. The Net therefore offers an empirical way to see what interactive media are good at, what they are poor at, and how such media might affect our lives.

At the core of the Net is the Internet, which now connects about 2 million computers and 20 million users. Begun as a military project during the Cold War, the Internet has become a giant, continuously evolving testbed of information services (reminiscent of sci-fi novelist William Gibson's description of a futuristic Japanese city: "a deranged experiment in social Darwinism, designed by a bored researcher who kept one thumb permanently on the fast-forward button"). Many commercially operated on-line services, such as Prodigy, America Online, and CompuServe, are linked to the Internet. A new user joins the Net on the average of every 10 minutes, doubling this electronic population each year.

Other than electronic mail, which has become familiar, three uses predominate on the Net. One is a global electronic bulletin board, called Usenet, which allows

people to post messages on any of thousands of topics. The second is real-time conversations—the computernetwork equivalent of CB radio. The third application, which I believe is least important though it tends to dominate policy rhetoric, is the retrieval of information from electronic libraries and other databases.

Usenet's "Global Mind"

Seven million people participate in the Net's vast array of on-line discussion groups, or "newsgroups," known collectively as Usenet. On a typical day, people throughout the world post 40,000 messages. Some types of discussion groups work better than others, and analysis of these electronic societies should give some insight into how future messaging systems should be designed and used.

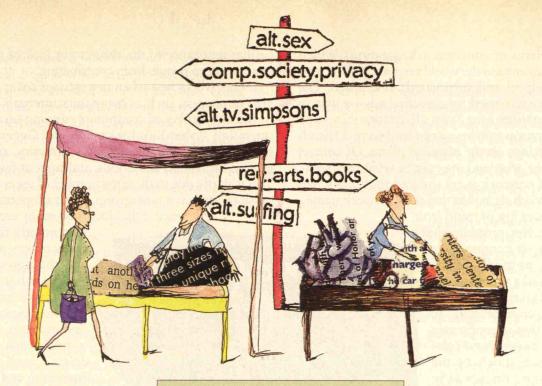
Each Usenet newsgroup is devoted to a specific subject, and users can post messages that will be seen by everyone else who "subscribes" to that group. Subscribing to a newsgroup means that you have asked the Usenet software on your computer to show you all the new messages in that group every time you use the program. A typical Usenet user subscribes to 10 or so groups, occasionally scanning a few dozen others.

Behind the scenes, Usenet works much like the office rumor mill. When you post a message it travels from your computer first to a local Usenet "server"—a computer with a large memory that stores copies of all current Usenet messages. The server then forwards a copy of the message to a handful of other servers it knows about, each of which in turn sends the message to a few other systems. In this fashion, your message is broadcast to every Usenet server in the world—arriving within seconds or days, depending on how far down the tree it had to travel.

There are nearly 2,000 newsgroups that are distributed globally and many more that are distributed locally. Newsgroups are arranged in a hierarchy of increasing specificity. For example, the discussion groups about computer systems all fall under the general category of comp.sys. This category is subdivided into groups such as comp.sys.mac (for discussion of Macintosh-related issues) and comp.sys.ibm (for IBM-compatibles). Moving down one level further, you find groups such as comp.sys.mac.graphics and comp.sys. mac.hardware. Starting a newsgroup in one of the major hierarchies—such as "comp," "rec" (for recreation), or "biz" (for business)-requires a vote showing a two-thirds majority in favor of the new group. There is also a hierarchy called "alt" (for alternative) with no such barrier to entry: anyone can start a new alt newsgroup at any time. Alt is home to the more risqué newsgroups such as alt.sex and alt.drugs, as well as discussion of popular culture (alt.tv.simpsons).

I first fell in love with Usenet after posting a query—a question about a software package—and then find-

STEPHEN STEINBERG is editor and publisher of Intertek, a journal about technology and society. He is a doctoral student in computer science at the University of California at Berkeley and a columnist for Wired magazine.



ing in my electronic mailbox the next morning the answer from seven people in three different countries. At such times Usenet seems like an oracle capable of answering even the most esoteric question. People take the time to answer my questions even though they do not know me and have nothing to gain.

What is it about Usenet that fosters such altruism? Most important is that being helpful is cheap: for most users, sending a message is free and takes less than a minute. Furthermore, users of this asynchronous medium can read and respond at their leisure—

no phone calls at inconvenient times owing to differing schedules or time zones. In an earlier age, before people began to specialize in narrow fields, it was possible to have a friend who knew almost everything. Today Usenet fills this role—it is a medium unrivaled for its ability to link the world's minds. At their best, Usenet discussions take on an epic quality as people across the globe wrestle with an issue, passionately championing an idea or a point of view. At worst, the discourse degenerates into incoherent name-calling.

I have found the most reliable indicator of which newsgroups will foster intelligent discussion to be the presence of a core set of users—"experts"—who have been active in the newsgroup for a long time. These users embody the history and structure of the newsgroup. This is important because Usenet has a short institutional memory; a typical Usenet server receives

EACH DAY,
PEOPLE THROUGHOUT
THE WORLD POST
40,000 MESSAGES
ON USENET'S 2,000
TOPICAL
'NEWSGROUPS.'

over 80 megabytes of messages per day, and so can usually offer only the last few weeks of messages for each newsgroup. This lack of history means that the same questions are asked, the same arguments break out, and the same mistakes are made over and over.

The group's experts serve as guides to ensure conversations stay on track, arguments are not repeated, and harsh personal attacks (known as "flames") are rapidly quelled. If the newsgroup is getting stuck on a question that was resolved months before, for example, the expert might post a message that explains what answer

the group arrived at. If someone is posting insulting or offensive messages, the expert might send private email reminding the guilty party of the rules of civility that prevail in the newsgroup. Long-term users also help promote a sense of community. As you read more messages from a person, your mental picture of him or her becomes more fleshed out, you come to know the person behind the cryptic user ID. As personalities emerge, a newsgroup begins to feel like a corner cafe with regular customers, traditions, and myths.

Many new communications media—from the printing press to the VCR—have been filled first with sexual material. Usenet is no exception. Three of the five most widely read newsgroups are devoted to erotic material (the other two are special newsgroups that provide information on Usenet itself). Most of the sexual discussion on Usenet resembles an advice column: peo-

ple with problems or concerns ask questions, which other users from around the world respond to. The tone is earnestly helpful and surprisingly restrained. The newsgroups are also used for classified ads—a way to find an e-mail partner for a "virtual" relationship—and it is not uncommon for these as to lead to real friend-ships and meetings on the physical plane. Of course, the person at the other end may not be what they seem. One survey of network users showed that many had tried gender-switching by altering their network name.

It is the distancing of mind from body that the Net provides that makes Usenet so conducive to matters of a prurient nature. Usenet eliminates much of the risk in sex and love, from embarrassment to commitment to AIDS, and allows users greater freedom in discussion and roleplaying. In fact, much of the frank discussion on sexually oriented newsgroups seems beneficial in that it allows people to ask questions they would not be able to otherwise. The rest of the traffic-sexually explicit stories and pictures—merely duplicates what is available through

Preventing chil-

other media.

dren's access to X-rated portions of the Net remains an unresolved issue. Most likely, as greater numbers of children begin to use the Net, mechanisms will evolve that are similar to "900 number" blocks—a service that phone companies provide that prevents an unauthorized person from dialing one of these numbers. Parents would thus be able to limit what portions of the Net are accessible from their child's account.

The same characteristics of Usenet that promote useful discussion can also prove detrimental. Anonymity, for example, not only fosters uninhibited discussion but also allows people to send inflammatory or harassing messages without fear of social censure. Many women who post on Usenet report receiving aggressive and crude e-mail messages. Technical solutions to this problem seemed doomed; every attempt to end anonymous messaging has led to the discovery of new network loopholes that allow it. Some people on the Internet offer "anonymous re-mailing" services—stripping off the "return envelope" information before forwarding Usenet posting or piece of e-mail to its designated recipient.

Because a newsgroup is a public space—inexpensively accessible by many people and controlled by no one—it takes only a few prolific users to pollute it with garbage. When adding your two cents costs nothing,

neither ignorance of the subject nor lack of relevance seems to keep people from contributing.

Usenet works best when newsgroups cover a specific area of interest, such as comp.unix.internals (devoted to the nitty-gritty of computers running on the Unix operating system) and sci.materials. General newsgroups, such as soc.history and sci.physics, are fecund ground for flames, falsehoods, and content-free blather. This is partly due to the large number of users these discussions attract; a newsgroup, like a telephone confer-

ence call, does not scale well. More

importantly, the lack of focus makes it unclear who the newsgroup is for, and what types of messages are appropriate. Sci. physics, for example, is home to a mishmash of physicists, well-meaning amateurs, and flat-out cranks. The result is sometimes interestingly eclectic, but the process often leads to acrimony as the cranks drown the newsgroup in tirades about time travel, experts try to stem errors and misconception (eventually admitting defeat and retreating to smaller, more

specialized newsgroups), and amateurs plaintively ask questions that are rarely answered.

One solution to these problems is the "kill file," a list of users whose messages are automatically made invisible to you—a programmable censor. Another approach is for the newsgroup to have a moderator who screens each message before allowing it to be posted. This runs the risk of bias: moderators may discard messages they disagree with. When all else fails, newsgroups may retreat to the safe harbor of a private e-mail list.

Choosing among these mechanisms is a difficult balancing act. If we erect too many fences, keeping out what we don't want to hear, we lose the friction and diversity that make for interesting discussions, and we diminish the sense of anarchic community that is so important to Usenet. But if we allow complete freedom, newsgroups can degenerate into uselessness, where content is buried beneath misleading or irrelevant messages. The future holds the promise of more intelligent filters that might, for example, tune out all messages in any newsgroup and from any sender that contain the words "gun control" (a favorite topic for flames)—or that would let through only some fraction of such messages, with this fraction being something each user could select.

A reliable indicator that a newsgroup will be free of

content is the smell of controversy. Obvious hot spots include talk.origins, where creationists and evolutionists shout past one another in the electronic ether, and talk.abortion. Tempers also flare in the soc.culture hierarchy, where newsgroup wars mirror real-world conflicts; soc.culture.croatia, for example, is an unreadable screaming match. Acute controversy on Usenet follows a predictable pattern: a flurry of messages quickly consumes the newsgroup, then messages begin to be "cross-posted" to other, vaguely related newsgroups

throughout the Net. The topic dies a slow death, killed by its own size as it becomes apparent that there are so many messages that no one is reading them. The outcome of the process is more heat than light.

Why doesn't Usenet produce more eloquent, literate debates? One popular explanation is that frequent flaming results from the absence of social and nonverbal cues-the winks, grimaces, and body language that help guide conversation. Another theory, which rings truer to me, was advanced by science-fiction author Bruce Sterling. The problem, Sterling says, is that Usenet messages are "ephemeral": when a message can be sent in a matter of seconds at virtually no cost to the sender, and has a life span

of only a few weeks, there is little incentive to spend much time on its content. Off-the-cuff remarks become the norm.

Usenet's greatest potential is as a global brain-bank and as a modern agora; it is a place where we can all be heard. It is where we can go to ask a question, or to experience the satisfaction of answering other people's. Usenet encourages participants to be helpful but discourages eloquence. It fosters a sense of community but becomes chaotic with too many people. It allows for honest discussion but also allows for harassment without retribution.

One danger lies in commercial adaptations of the system that erect too many fences—banning topics or language that may offend some people—or that serve the needs of advertisers rather than users. Some of today's on-line services, such as Prodigy and America Online, have already taken this path and erred on the side of caution. These services forbid, among other things, swearing, sexual discussion, and criticism of the service itself. This censorship results in a sterile shopping mall instead of a marketplace of ideas—a lobotomized Usenet where the noise-level is low but the discussions lack vitality and spirit.

Real-Time Chatter

If Usenet is the Net's magazine stand, a different class of media is emerging as the Net's answer to radio and television. The best examples are IRC (Internet Relay Chat) and MUDs (Multi-User Dimensions). While a Usenet message may take a few days to propagate around the world, an IRC or MUD message arrives on users' screens in a matter of seconds. IRC and MUD messages are carried over the Internet in the same com-

puter-to-computer fashion as Usenet messages, but they go only to those people who are currently listening. Unlike Usenet posts, IRC and MUD messages are not saved anywhere for later perusal. Messages are passed from computer to computer the way relay runners hand off a baton. The "conversations" that result are much more akin to talking on CB radio than to an exchange of e-mail.

To use IRC, you first connect to an IRC server (there are dozens in the United States and Europe) and then choose a channel to join. You could then type "hello, world," and as soon as you hit the return key, the message would travel to the server, which would then instantly forward a copy to the dozen or so other people who

are listening to that channel. At any one time there may be 80 different channels, each with a distinct name, such as #hottub or #china, and two to forty participants. Anyone can create a new IRC channel, and the creator has special commands to control who can then tune in to that channel. IRC is accessible to anyone on the Internet and it attracts users from sixty different countries—a diversity of time zones that ensures there is always someone to talk to.

MUDs are a cross between IRC and role-playing games. Like IRC, MUDs allow for real-time communication among multiple users who are all linked to a common server. In a MUD, however, the server also provides the illusion of a virtual world. Each MUD presents its own geography and theme, from medieval Europe to bizarre alien realms. Rather than channels, as in IRC, there are "rooms"—such as ballrooms, closets, and prisons—each with its own entrances, objects, and written description. Players can create new rooms and objects (I opened a tavern on one system), which other players can then use.

The MUD interface is reminiscent of early computer adventure games. Type "go north," for example, and the screen might display: "You have entered a musty,

FAQS

Most Usenet newsgroups have a corresponding FAQ—a list of "frequently asked questions" and their answers. These are often valuable resources in their own right, containing the distilled wisdom of the newsgroup. The fastest way to get a copy of a FAQ is through anonymous FTP (file transfer protocol) from the storage site rtfm.mit.edu (a computer at MIT). At the Internet prompt, type:

FTP RTFM.MIT.EDU

When asked for your user name, type:

ANONYMOUS

To get the FAQ for a particular newsgroup, you have to go to the right directory. Type:

CD /PUB/USENET/<NEWSGROUP NAME>

To list all the files in this directory, type:

LS

To retrieve the file you want into your computer, type:

GET <FILENAME>

IRC

To connect to IRC—the Net equivalent of CB radio—you will need a special IRC client program. It may already be installed on your system; check by typing the command "irc" at the Internet prompt. If the system declares an error, you will need to download and install the client yourself. The program can be obtained with anonymous FTP from cs.bu.edu, in directory /irc/clients. (Follow the same basic procedure given above under FAQs.)

Once you have the client up and running, connect to an IRC server with the command /SERVER irc.colorado.edu. You are now on IRC. For a list of channels, type:

/LIST

To begin communicating on one of

Ten Tools for the Internet

THE NET IS STILL A

FRONTIER—DIFFICULT TO

USE AND WITH A RAW

INTERFACE ONLY A COMPUTER SCIENTIST COULD

LOVE. HERE ARE

10 POINTERS TO HELP

YOU FIND YOUR

WAY AROUND.

these channels, type:

JOIN < CHANNEL-NAME>

MUDs

Each MUD is a different world. Themes range from cyberpunk to sword and scorcery. One of the most popular is LambdaMoo, run by Pavel Curtis at Xerox PARC. To enter the LambdaMoo world, type:

TELNET LAMBDA.PARC.XEROX.COM 8888

Once connected you will be given directions on how to create a new character.

LambdaMoo is used mainly for conversation. A more game-oriented MUD is Apocalypse IV, which can be entered by typing:

TELNET PEABRAIN.HUMGEN.UPENN.EDU 4000

The MIT Media Lab operates a more serious MUD, MediaMOO, intended for

researchers interested in issues surrounding interactive media. An application is required to become a member. To join, type:

TELNET PURPLE-CRAYON.MEDIA.MIT.EDU 8888.

Gopher

Gopher is a tool with an easy-to-use menu interface that allows you to connect to other sites and then search through databases and retrieve information. Check if Gopher is already installed on your system by typing the command "gopher." If that doesn't work, you can download the program with anonymous FTP from boombox.micro.umn.edu, in the directory /pub/gopher.

You can use this to go to many interesting places on the Net. Type:

GOPHER LIFE.ANU.EDU.AU

to reach a source of biology information;

GOPHER MENTOR.LANL.GOV

for physics resources; and

GOPHER GOPHER.CIC.NET

for a huge library of electronic magazines.

Mosaic

Mosaic is similar to Gopher but has a fancy graphical hypertext interface. Because the graphics need to be transmitted to your computer, Mosaic works best if you have a fast connection to the Internet—at least 19,200 bits per second. You can FTP Mosaic from zaphod. ncsa.uiuc.edu; switch to the directory /Mac/Mosaic or /PC/Mosaic depending on which version you need. The Mac program is called NCSAMosaicMac.-103.sit.hqx; the PC version is wmos20a4.zip.

When you run Mosaic you start off at a "home page." You can either explore from there, or jump directly to other "links" by using the menu command "Enter URL." Links that take full advantage of Mosaic include the Dead Sea Scroll exhibit at http://sunsite.unc.edu/ expo/deadsea.scrolls.exhibit/intro.html

and the on-line computer science textbook project at http://compsci.cas.vanderbilt.edu/csep.html.

Netfind

Finding a person's e-mail address is often difficult because there is no complete "white pages" for the Net. One tool that goes a long way toward solving this problem is Netfind. Given a name and some keywords about where a person works or goes to school, Netfind will search through many different local white pages.

To use the service, type:

TELNET MUDHONEY.MICRO.UMN.EDU

When asked for a user ID, type:

NETFIND

The menu-driven interface will take you from there. Although large portions of the Net are invisible to Netfind, this is still the best people-finding tool available.

Archie

Archie is similar in spirit to Netfind, except instead of looking for people, Archie will search hundreds of different sites for a specific file. This is useful when you are trying to track down a public domain program whose name you know, such as Gopher or Mosaic.

If Archie is installed on your system, begin a search by typing:

ARCHIE <FILENAME>

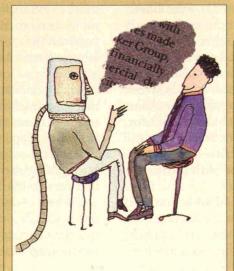
Otherwise, type:

TELNET ARCHIE.RUTGERS.EDU

and log in as "archie." Then, to perform a search, type:

FIND <FILENAME>

If Archie is successful it will print a list of sites where the file is located, and you can then use anonymous FTP to retrieve the file.



THE NET SOMETIMES
SEEMS LIKE AN ORACLE
CAPABLE OF ANSWERING
EVEN THE MOST
ESOTERIC OF
QUESTIONS.

Libraries

Not all of the Library of Congress is online yet, but a growing amount can be searched by gophering to marvel.loc.gov. Another large on-line library catalog system is Melvyl, which covers the entire University of California system. While some parts of the catalog require a password, most of it is publicly accessible. Type:

TELNET MELVYL.UCOP.EDU

You can also use telnet to tap Harvard's library at hollis.harvard.edu, and Yale's at umpg.cis.yale.edu 6520.

Weather

Much of the weather information that ends up in your morning newspaper can be found on the Net in its undistilled form. Type:

GOPHER ASHPOOL.MICRO.UMN.EDU

Select weather from the menu that is offered. From here you can get weather predictions for any U.S. city or download current satellite images. It is popular in some circles to use these images for your screen background. Note that to view these images you will need a program that can display graphics files in the "gif" format. Public-domain gif viewers are available from several FTP sites, such as mirror.archive.umich.edu.

Games

The potential for multiuser games has not gone unnoticed among the Net community. You can play backgammon against opponents throughout the world by telnetting to fraggel65.mdstud.chalmers.se 4321, or you can play the game of Go by telnetting to hellspark.wharton.upenn.edu 6969. The Go system includes an automatic ranking system so that players are matched with others of similar skill. A less traditional game is Net-Trek—a graphical, addictive, and highly complex space simulation. To play, you will need to download the client, available from ftp.cd.chalmers.se in the directory /pub/netrek.

Getting Access

To get on the Internet you need a computer, a modem, telecommunications software, and an account. Most Internet users have accounts through their school or employer. Individuals can get access through any of several companies. Here are three:

CRL NETWORK SERVICES:

\$17.50/month gives unlimited hours; \$19.50 setup fee. Phone: 415-837-5300.

NETCOM:

\$17.50/month gives unlimited hours; \$20 setup fee. Phone: 408-554-8649.

SOFTWARE TOOL AND DIE:

\$5/month plus \$2/hour, or \$20 per month plus \$1 for each hour after the first 20 hours; no setup fee. Phone: 617-739-0202.

abandoned warehouse. You see another player behind some weathered crates." The first MUDs were simply games that allowed people to move about an imaginary universe while killing monsters and other players. But talking with the other players turned out to be more popular than killing them, and now most MUDs are intended as virtual hang-outs—exotic worlds where people can gather and chat without leaving their chairs. There are about 300 active MUDs at any given time, each with its own set of regular users. MUDs are still something of a cult, and their population—an estimated 20,000 worldwide—is tiny compared with the readership of Usenet.

ÎRC and MUDs are entertaining and addictive; tales of ruined relationships and failed classes resulting from long nights spent in front of the computer are common. What makes this surprising is that these systems have

solitary nor completely vicarious and, as a result, it is more emotionally real. In fact, MUDs and IRCs are far more social than either reading or watching a movie. A party on IRC *feels* like a party, and when you explore a labyrinth on a MUD you begin to type nervously, keeping your head low.

MUDs do not foster deep discussions. Users engage in multiple simultaneous conversations: while I wait for a response to my first message, I begin to type a new question (slow typists are the social misfits of MUDs and IRC). With only a few participants this is manageable, but with more than five or so people on the channel it becomes distracting. It is as if you were at a party and could hear every conversation equally well—and everyone is juggling two conversations at once. Because of this clamor, conversations usually consist of simple banter: messages are short (less than 10 words), and hesitating to think is discouraged; the

HISTORICALLY, NEW FORMS OF COMMUNICATION HAVE PROFOUNDLY CHANGED THE WAY PEOPLE THINK.

time-line

none of the computer graphics or special effects we expect of modern entertainment. With only the 94 ASCII characters that can be produced by typing on a standard computer keyboard, users construct a parallel world that is sometimes more compelling than our own. In these virtual worlds, identity becomes malleable: our gender is what we say it is. This not only changes how we interact (by eliminating the social cues we are accustomed to) but also destroys the notion that identity is rooted in the body. The ability to collectively create a world out of words stretches the imagination and exercises our intelligence in ways television cannot.

People who have not used IRCs and MUDs sometimes deride them as mere escape for people who are socially inept in "real life." This shows blindness toward these media's capabilities, and ignores the factors that have made other forms of entertainment successful. While typing at a computer screen sounds about as interactive as doing your taxes, the mechanics of reading a novel or watching a movie do not sound very compelling either. This new medium should likewise be seen not as a poor replacement for real life but rather as a way to have experiences that would otherwise be impossible.

As with reading a novel, taking part in MUDs and IRCs allows us to expand our experience through an alter ego. But in this new case the experience is neither

medium fosters the textual equivalent of "sound bites." Although this forced brevity makes IRC and MUDs less than ideal for, say, scholarly discussions, bars and dinner parties do not lend themselves to scientific discussion or complex oratory either, yet they remain important to society.

What MUDS are good at is fostering friendships between people who live far apart, at allowing people who are usually inhibited to express themselves. They also provide a unique entertainment form that allows people to cooperatively create different worlds and identities. Because the medium is more interactive, more visceral, than Usenet, the friendships that form are closer and the community is more tightly knit. Most MUD users seem to feel a sense of responsibility for keeping the system running smoothly that is found only rarely among Usenet participants.

IRC and MUDs have been less successful at tasks outside of casual communications. During the September 1993 coup attempt in Russia, for example, IRC users in Moscow typed in updates as everyone gathered around; this is often cited as an example of IRC's usefulness as a news medium. But television is likely to remain better for updates on breaking news—especially as ultraportable satellite uplinks are making it possible to broadcast live video from anywhere on earth at any time.

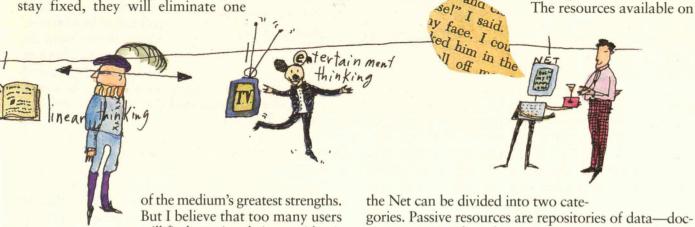
As virtual meeting places, MUDs could serve as

venues for scientific conferences. MIT and Xerox PARC researchers have pursued this idea, but so far, at least, it has not caught on. Live and in-person gatherings are still the rule—and scientists who are interested in electronic meetings have found videoconferencing a more effective medium.

Most of the commercial on-line services offer an equivalent of IRC. A few, such as CompuServe and America Online, also offer environments similar to MUDs. These pseudo-MUDs are less powerful than those on the Internet, limiting the ways in which users can modify and extend the virtual worlds. But many companies—not only on-line service providers but also entertainment companies such Lucasfilm—are intently exploring future offerings in this medium. If commercial service providers, afraid of the ambiguity in today's MUDs, insist that real names be used and descriptions stay fixed, they will eliminate one

esoteric commands like "telnet" and "ftp." Gopher uses a menu-driven interface. Mosaic adds a further level of abstraction with an attractive, graphical interface that allows the user to jump from one topic to another with a click of the mouse.

But even with this kind of aid, it's easy to get lost on the Net; the sheer size of the place is disorientating. It is like using an encyclopedia: something will catch your eye and you end up perusing an interesting side path and then are not sure how to get back. If you know exactly what you are looking for it is better to use the tour guides of the Net, programs such as WAIS (for wide area information service) and Veronica. When you type in keywords, these programs will search hundreds of different databases and then either display the information you seek or point you to where you need to go to find it.



But I believe that too many users will find creating their own identi-

ties compelling, and will discover ways to do so.

Dipping into Info Oceans

When Vice-President Al Gore talks about the information highway, he rarely extols it as a way to meet people. Instead, he speaks of schoolchildren looking up information in electronic libraries. This is like promoting the telephone as an emergency tool for the elderly—it focuses on a marginal, albeit important, application while ignoring the medium's main use. Yes, the Net offers access to a vast collection of information resources. But most people who inhabit the Net use it chiefly for human-to-human contact, not for gathering information from computer databases. One reason for this preference is that, all rhetoric aside, information on the Net is difficult to find. Every Internet newcomer ("newbie") quickly learns how daunting it is to explore the labyrinth of the Net—it's like being lost in a foreign country where the maps are out of date.

Fortunately, the situation is improving. New programs that serve as maps, such as Gopher and Mosaic, are becoming available (see "Ten Tools for the Internet," page 26). These programs provide consistent interfaces to Net explorers, minimizing the need to master

gories. Passive resources are repositories of data—documents, scientific information, or pieces of software stored on some computer on the Net—that users can retrieve, or download into their own computers. Active resources, such as electronic libraries and on-line weather bureaus, take advantage of the Net's interactive nature to provide services that previously would not have been possible. For example, you can view a weather map of the country and then zoom in on a region of interest.

Passive resources, which are more common, speed the distribution of information. But its benefits are limited. Once I download a document, I usually print it out so that I can read it on the train and scribble in the margins. So if distribution is already convenient, having the resource available electronically is unnecessary. Few people read the *New Republic* or *Technology Review* electronically (although both are available on the Net) because it is just as easy to pick them up at your mailbox or local newsstand.

Passive resources are unsuited for information that costs someone a lot of money to produce. Publishers, for example, are wary of making books available on the Net because people can easily repost the text elsewhere, violating copyright law and ending the publisher's control of the material. This has led some people to argue that the Net will fundamentally alter our notions of

information ownership, and that the concepts of copyright and intellectual property cannot be reconciled with the fluidity of digital information. This battle over intellectual property law, now being fought in the courts, will as much as any purely technological factor alter the shape of future interactive media.

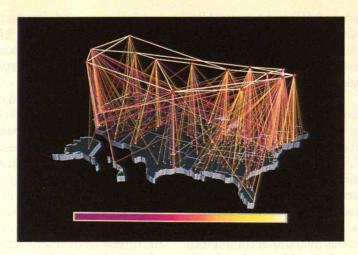
Laws that are overly strict in their definition of "fair use" will eliminate a key advantage of digital media—the ease of modifying and combining pictures and text to suit individual needs. But if the laws are made too weak,

and do not adequately protect the efforts of information providers, there will be little incentive to offer these resources at all. I believe copyright laws will be weakened as publishers realize they must loosen their control if they wish to stay competitive in a digital world. People will demand the ability to shape and manipulate information so that it suits them, but they will still pay money for information that is timely, convenient, and well-packaged.

Active resources raise a different problem. As the repeated failures of home banking and videotex suggest, most people do not want to interact with computers. At best, such interaction is something they grudgingly put up with. It is no coincidence that the Home Shopping Network, which many people see as the forerunner of interactive TV, has "live" people describing products rather than just prerecorded demos. Although the success of automated teller machines is often held up as a counterexample to this computer aversion, this is one of only a few uses where the advantages so outweigh the public's distaste toward communicating with machines.

Broader use of interactive services may be catalyzed by the development of electronic "agents"—intelligent programs that filter and retrieve information on your behalf. Think of agents as secretaries who live inside the network and, by watching your actions, learn your informational needs and interests. A simple example of an agent is the Usenet kill file, which filters out messages from designated senders. In the future, agents will become more sophisticated: you might have an agent that knows from your schedule that you are flying to Memphis and so retrieves the relevant weather information without an explicit request from you.

As intelligent software robots like this become more common, the network of resources will turn into



Enormous amounts of information course through the Net. During one typical month, traffic volume on the NSFNet—the backbone of the U.S. portion of the Internet—varied from zero bytes (purple) to 100 billion bytes (white).

a computer-to-computer medium. Ultimately, agents will make the network transparent. Schoolchildren of the future, for instance, will probably look up information in electronic libraries (undoubtedly pasting the text into their reports, free from the drudgery of retyping encyclopedia entries). But they won't think of it as using "electronic libraries" any more than today's students think of books as "bound-together stacks of paper." They will just know that if they want more information about a sub-

ject, they can issue a typed (or someday, handwritten or spoken) request and the computer will fetch what they have asked for.

Toward the Interactive Millennium

Although they will play an important part in people's lives, the Net's new media have too many weaknesses to be the newspaper or TV killers that pundits sometimes predict—and they certainly will never replace the intimacy of face-to-face communication. A bulletinboard messaging system such as Usenet works well as a global oracle but breaks down when used for discussion of controversial or overly general topics. Real-time electronic interaction through IRC and MUDs has enormous entertainment potential, but constrains conversation to simple chatter. And while network resources will grow more useful and more popular, it will be many years before they offer the visual richness and ease of use that will be required to become truly pervasive.

Many newcomers to the Net are struck first by how raw it seems, with its poor spelling and occasionally crude content. These new media are a far cry from the processed and filtered products we are accustomed to. These rough edges are an important part of what makes the Net compelling—but it is also the aspect most likely to be lost in commercial adaptations. For while the Net has so far been driven by users' desires and funded largely by the government, the information highway that is starting to emerge will be driven by what is commercially viable. These forces often overlap—to be commercially successfully, a service must attract users. But there is an important difference that will fundamentally shape the media: advertising. As government support inevitably recedes, commercial sponsors will fill the

funding void, subsidizing the services we want but could not otherwise afford. Market forces are not necessarily ruinous; the Greek agora, after all, was used for both commerce and communication. But some of the strengths of the Net do seem to conflict with advertisers' interests.

I draw three lessons from the Net's successes and failures. Advertisers and service providers will resist the implications of these lessons. But we should heed them if we want to ensure that interactive media fulfill their promise:

The information highway must be two-way. The Net allows all of us to be storytellers, orators, and publishers. Usenet works because answering someone's question—producing content—is just as gratifying as having your own questions answered. This explains in part why the Net has quickly grown to resemble a giant bazaar,

with thousands of people offering information on some esoteric area or designing and running a MUD based on their favorite sci-fi story—all for no commercial gain.

Service providers and advertisers are uncomfortable with this blurred line between information "consumers" and "producers" because it means losing control over content. This is why the first interactive offerings are likely to be one-to-many services, like video-ondemand—a six-lane highway into our homes with a dirt trail going out. To prevent this, regulators need to ensure that the information highway is what cyberspace guru Mitchell Kapor—cofounder of the Electronic Frontier Foundation—calls an "open platform." That is, the network must be open to anyone who wants to provide content, whether it be pictures of a recent trip or a dating channel, just as the PC is open to anyone who wants to develop software.

■ We must have the same freedom of speech we have in other media. What we say should not be controlled by who owns the wires. More controversially, I believe that users should have a way of remaining anonymous, with the system therefore encouraging open discussion, even on sensitive subjects and personal issues. Advertisers do not like users to be anonymous. They want to be able to build customer profiles so they can, for example, target advertisements for Scotch to affluent people. To satisfy both sides, perhaps a neutral gatekeeper could be entrusted with profile information—ensuring that ads go to the right people while keeping advertisers from knowing individual names. Such "pseudonymity" would be a reasonable compromise between anonymity,

EXTOLLING THE NET

AS A WAY TO TAP

LIBRARIES IS LIKE

PROMOTING THE PHONE

AS AN EMERGENCY

TOOL FOR THE

ELDERLY—A MARGINAL,

ALBEIT IMPORTANT,

APPLICATION.

accountability, and privacy.

The Net did not take off as an interactive medium until the population grew beyond the scientific community. Diversity makes discussions more interesting and allows for a wider pool of knowledge: Usenet messages are now posted by everyone from homeless poets to rock stars, and on IRC you are as liable to meet a Finnish banker as a high-school student in Georgia.

The Clinton administration has trumpeted universal access to what it calls the national information infrastructure, but has been short on details. Does access simply mean that the physical wire is available, or must it also be at a price everyone can afford? Will universal access be ensured by government regulations, as with telephone service, or do we trust that market forces will guarantee

availability and drive prices sufficiently low?

Determining the correct balance will require continued debate over what interactive media is good for and how it should be used. To the extent that the Net offered mainly entertainment, guaranteed access to it would be no more imperative than equal access to, say, Broadway shows. But the Net is in fact becoming a "place" where business is done and where one can get information and tools not readily available elsewhere. It therefore becomes essential that the Net not bypass the poor and those living in rural areas—people who would benefit the most from electronic resources.

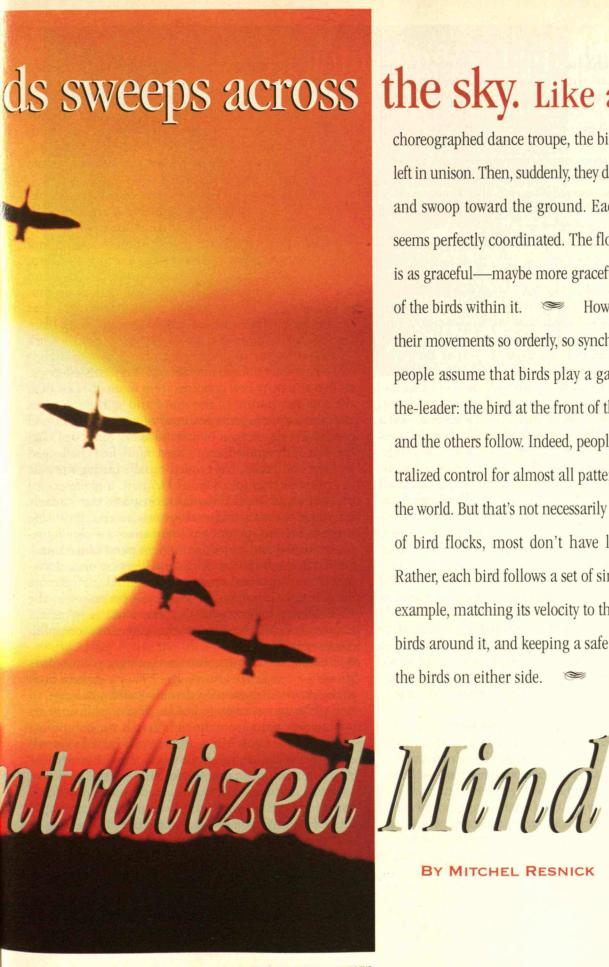
We need to think about these issues now, before they are decided for us. Interactive media are still new and relatively rare—the trajectory of the technology has not been set. This means that we as consumers, as regulators, and as designers still have time to shape the medium—to make the most of what it does well and to improve its weak points. If we close our eyes and do not try to predict the uses and effects of interactive media, we will likely come to regret the path that market forces have pushed us down.

My hope is that interactive media will improve our lives and augment our intelligence in ways far more substantial than quick movie delivery or multiplayer videogames. While in junior high I believed the Net to be a magical world with infinite potential, but I also believed that I would soon be commuting to work by jet-pack. I have given up on the latter scenario, and now I hope my vision of a global agora does not prove to be a mirage as well.

A flock of b

Changing the Ce

Contrary to conventional ways of thinking, not every complex pattern is the result of careful planning by a central authority. A better understanding of decentralized phenomena can provide new insight into the world around us.



the sky. Like a well-

choreographed dance troupe, the birds veer to the left in unison. Then, suddenly, they dart to the right and swoop toward the ground. Each movement seems perfectly coordinated. The flock as a whole is as graceful—maybe more graceful—than any of the birds within it. How do birds keep their movements so orderly, so synchronized? Most people assume that birds play a game of followthe-leader: the bird at the front of the flock leads, and the others follow. Indeed, people assume centralized control for almost all patterns they see in the world. But that's not necessarily so. In the case of bird flocks, most don't have leaders at all. Rather, each bird follows a set of simple rules, for example, matching its velocity to that of the other birds around it, and keeping a safe distance from the birds on either side. A bird flock is

BY MITCHEL RESNICK

one of many phenomena organized without an organizer, coordinated without a coordinator. In ant colonies, trail patterns are determined not by the dictates of the queen ant but by local interactions among the worker ants, such as following a scent that their fellow ants emit when they find a source of food. In human societies, macroeconomic patterns arise from the haggling between millions of buyers and sellers in marketplaces and stock markets around the world. And in immune systems, armies of antibodies seek out bacteria in a systematic, coordinated attack—without any "generals" organizing the overall battle plan.

The Era of Decentralization

A growing number of people are now choosing these kinds of decentralized models for the organizations and technologies they construct in the world, and for the theories they construct about the world. One such case began to unfold on December 7, 1991, when Russian President Boris Yeltsin met with the leaders of Ukraine and Belarus in a forest dacha outside the city of Brest. After two days of secret meetings, the leaders issued a declaration: "The Union of Soviet Socialist Republics, as a subject of international law and a geopolitical reality, is ceasing its existence." With that announcement, Yeltsin and his colleagues sounded the final death knell for a centralized power structure that had ruled for nearly 75 years. In its place, the leaders established a coalition of independent republics and promised a radical decentralization of both economic and political institutions.

The next day, halfway around the world, another powerful institution announced its own decentralization plans. IBM chairman John Akers publicly announced a sweeping reorganization of the computer giant, dividing the company into more than a dozen semi-autonomous business units, each with its own financial authority and its own board of directors. The goal was to make IBM more flexible and responsive to the needs of rapidly changing markets.

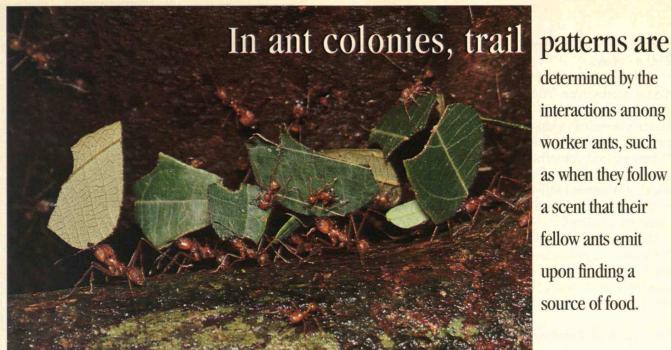
The coincident timing of the above two events actually symbolizes a broad decentralization trend that is sweeping through many different domains. For example:

■ ORGANIZATIONS: All types of organizations—schools, companies, even countries—are pushing authority and power down from the top, distributing rights and responsibilities more widely. In U.S. education, for example, decentralization extends to several levels. School choice brings market-oriented thinking to the

world of education, asserting that individual families not state or local governments—should decide where their children go to school. Likewise, school-based management moves decision-making authority from state and district offices to individual schools. And childcentered learning, now adopted in many classrooms, transforms the teacher from a central authority into a catalyst, coach, and collaborator.

- SCIENTIFIC MODELS: For 300 years, researchers' thinking has been guided by Sir Isaac Newton's model of the physical world as a clocklike mechanism. Newton's world is ruled by a centralized notion of cause and effect—one gear turns, which makes another gear turn, and so on. Now, a new set of decentralized models and metaphors is spreading through the scientific community and gradually into the culture at large. Researchers now view a wide range of systems—everything from bird flocks to immune responses—less like clockwork mechanisms and more like complex ecosystems controlled by decentralized interactions and feedback loops.
- PSYCHOLOGY: Few concepts seem more obvious than the singular nature of the mind and self. Each of us experiences life as a single thread of consciousness, and each of us imagines our own mind as "I," not "we." But the idea of the unified, centralized mind, first challenged by Sigmund Freud, has eroded rapidly during the past decade. For example, Daniel Dennett, a professor of philosophy at Tufts University, proposes that there is no single stream of consciousness in the mind. He suggests instead that multiple narratives are simultaneously created and edited in different parts of the mind. Similarly, the field of artificial intelligence, once dominated by centralized models of the mind, now favors decentralization. Marvin Minsky, a professor at the MIT Media Lab, argues that the mind is a society of many simple agents that work together to accomplish complex tasks.
- THEORIES OF KNOWLEDGE: For centuries, philosophers strove for "objective knowledge." They put great faith in the power of logic to systematize all knowledge, to find ultimate meaning and truth. Today, philosophers are moving away from the notion of a single unifying conception of knowledge, arguing instead that knowledge speaks not with a single voice but with many. For example, traditional theories of literary criticism assumed that meaning was created by an author and conveyed through the author's writings. According to this view, reading is a search for inherent meaning in a document, an attempt to decipher the intention of the author. But modern schools of thought—such as poststructuralism, reader-response theory, and deconstructionism—all focus on readers as the main constructors of meaning. In this new view, texts have little or no inherent meaning. Rather, meanings are constantly reconstructed by communities of readers

MITCHEL RESNICK, an assistant professor at the MIT Media Laboratory, specializes in the development of computational tools to help people learn new things in new ways. The ideas in this article are explored further in his new book, Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds, published this month by MIT Press.



determined by the interactions among worker ants, such as when they follow a scent that their fellow ants emit upon finding a source of food.

through their interactions with the text. Meaning itself has become decentralized.

Centralized Thinking

Even as the influence of decentralized ideas grows in many disciplines, a deep-seated resistance to such ideas remains. People seem to have strong attachments to centralized ways of thinking, assuming that every pattern must have a single cause, an ultimate controlling factor. The widespread resistance to evolutionary theories is an example: Many individuals still insist that someone or something must have explicitly designed the complex, orderly structures that exist in the biological world. They resist the idea that complexity can be formed through a decentralized process of variation and selection.

Similarly, many view the workings of the economy in centralized ways, assuming singular causes for complex, decentralized phenomena. In interviews with Israeli children between 8 and 15 years old, for example, David Leiser, a psychologist at Ben-Gurion University, discovered about 10 years ago that nearly half of the children assumed that the government sets all prices and pays all salaries. Even children who said that employers pay salaries often believed that the government provides the money for the salaries. "The child finds it easier to refer unexplained phenomena to the deliberate actions of a clearly defined entity, such as the government," he wrote, "than to impersonal market forces."

The centralized mindset is not just a misconception of the scientifically naive. A similar bias toward centralized

theories can be seen throughout the history of science, with scientists remaining committed to centralized explanations even in the face of discrediting evidence. The history of research on slime-mold cells, as told by Evelyn Fox Keller, a professor of science, technology, and society at MIT, provides a striking example. At certain stages of their life cycle, slime-mold cells gather into clusters. Scientists long believed that this aggregation process was coordinated by specialized slime-mold cells, known as "pacemaker" cells. According to this theory, each pacemaker sends out a chemical signal telling other slime-mold cells to gather around it.

In 1970, Keller and a colleague proposed an alternative model, showing how slime-mold clusters can form without any specialized cells. In this model, every individual slime-mold cell emits a chemical signal and follows signals produced by others. The result: aggregation without a leader. Nevertheless, for the following decade, other researchers continued to assume that pacemakers were required to initiate aggregation. As Keller writes, with an air of disbelief: "The pacemaker view was embraced with a degree of enthusiasm that suggests that this question was in some sense foreclosed."

It is not altogether surprising that people have strong commitments to centralized approaches. Many patterns and structures in the world are, in fact, organized by a central designer. When we see neat rows of corn in a field, we assume correctly that the corn was planted by a farmer. When we watch a ballet, we assume correctly that the movements of the dancers were planned by a choreographer. When we participate in social systems, such as families and school classrooms, we often find that power and authority are centralized, often

PHOTO: PHOTO RESEARCHERS INC. TECHNOLOGY REVIEW 35 excessively so. These phenomena reinforce the centralized mindset.

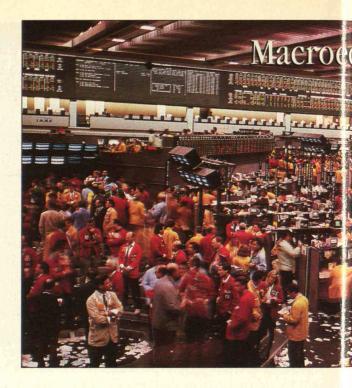
Another important factor is the way people think about themselves. Your mind (like all others) is composed of thousands of interacting parts. But you experience yourself as a singular being. This is a convenient, perhaps necessary, illusion for surviving in the world. When you do something like paint a picture or organize a party, you feel as if you are playing the role of the central actor. Only one entity seems to be in charge: you. So people naturally expect most systems to involve a central authority.

By clinging to this centralized mindset to explain all phenomena, politicians, managers, and scientists are working with blinders on, focusing on centralized solutions even when decentralized approaches might be more appropriate, robust, or reliable.

Decentralized Thinking Tools

To help people move beyond the centralized mindset and learn new ways of thinking about decentralized phenomena, I developed a new computer programming language called StarLogo. This language allows people to control the actions of thousands of graphic creatures on the computer screen. The user writes simple rules for the creatures and the environment in which they live and then observes the group behaviors that emerge from their interactions. For example, a user might write simple rules for individual birds, then observe how the flock behaves.

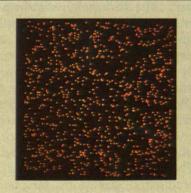
In one StarLogo simulation, inspired by the controversy over slime-mold aggregation, the artificial creatures follow two simple rules: they emit a pheromone (chemical attractant) and, after "sniffing" the local area, move in the direction in which the pheromone is strongest. At the same time, the environment causes the pheromone to diffuse and evaporate. With this simple strategy, the creatures quickly assemble into clusters. The reason: When a few creatures get near one another just by chance, they create a pheromone "puddle,"

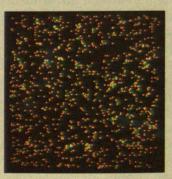


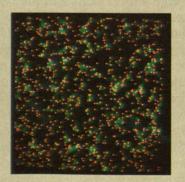
which attracts even more creatures, making the puddle even bigger, and so on.

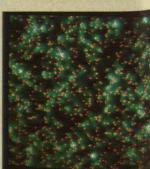
I have worked with several groups of high school students who have created decentralized "microworlds" using StarLogo. In one experiment, two students—Ari and Fadhil—wanted to study traffic jams. So they created a one-lane highway with a police radar trap to catch cars going above the speed limit. They then programmed each driver to follow three simple rules: If you come within two car lengths of the car in front of you, slow down. If no cars are within two car lengths ahead of you, speed up until you reach the speed limit. If you detect a radar trap (each car is equipped with a detector), slow down.

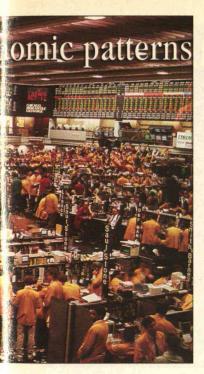
Both students expected that a traffic jam would form behind the radar trap, and indeed it did. As cars slowed down for the trap, the cars behind them were forced to slow down, creating a queue with roughly equal distances between the cars. When the cars moved beyond the trap,











arise not

from a centralized authority but from haggling between millions of buyers and sellers in stock markets and marketplaces around the world.

they accelerated smoothly until they reached the speed limit.

I asked the students what would happen if they removed the radar trap. The cars would be controlled by just two rules: if you see another car close ahead, slow down; if not, speed up. They predicted that the traffic flow would become uniform; cars would be evenly spaced, traveling at a constant speed. When we ran the program, however, a traffic jam formed. Along parts of the road, the cars were tightly packed and moving slowly. Elsewhere, they were spread out and moving at the speed limit.

At first, the students were shocked. Their comments revealed the workings of a centralized mindset: They argued that traffic jams need some sort of centralized "seed," like a radar trap or accident, in order to form. They couldn't believe that simple interactions among cars could create a jam. But as they continued to experiment with the simulation—modifying the speed and starting positions of the cars—they developed an under-

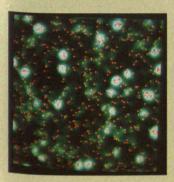
standing of how the traffic jams formed. When a few cars, by random chance, happened to get near one another, they slowed down, making it likely that even more cars behind them would have to slow down, leading to a jam.

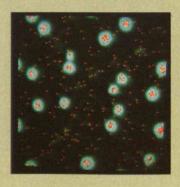
Another student, Callie, chose to use StarLogo to simulate the behavior of termites. Termites are practically blind, yet they are considered the master architects of the insect world. In fact, on the plains of Africa, termites construct giant moundlike nests containing intricate networks of tunnels and chambers. Many people assume that the queen of the termite colony tells the blind workers what to do. But, as in ant colonies, the queen is more of a mother to the colony than a leader. On the termite construction site, no one is in charge of a master plan. Rather, each termite carries out a series of relatively simple tasks, relying on its sense of touch and smell.

Termites are thus well suited for StarLogo explorations. Callie started with the following goal for her StarLogo termite colony: Termites should gather randomly scattered wood chips and put them into a few orderly piles. As with real termites, she didn't want to put one termite in charge. Instead, she programmed each termite to walk around randomly, obeying two simple rules: If you are not carrying anything and you bump into a wood chip, pick it up. If you are carrying a wood chip and you bump into another one, drop the chip.

At first, we were both skeptical that this decentralized strategy would work. The strategy did not prevent termites from taking wood chips away from existing piles. So while termites were putting new wood chips on a pile, other termites might be taking wood chips away from it. It seemed like a good prescription for getting nowhere. But we ran the program with 1,000 termites and 1,500 wood chips.

Much to our surprise, the number of piles steadily declined and the number of wood chips in each pile grew. After several program iterations—in each iteration every termite took a step or picked up or dropped a





A computer simulation shows that slime-mold cells (orange dots) can aggregate without a leader if they follow two simple rules. First, drop a pheromone (a chemical attractant shown in green) while wandering randomly. Second, while "sniffing"

the area, move toward the strongest pheromone scent. When a few cells move near each other by chance, they create a pheromone puddle, prompting them to stay near the scent and release even more pheromone, thus attracting still more cells.

chip—the wood chips had been gathered into hundreds of small piles. After 2,000 iterations, there were 100 piles with an average of 15 wood chips in each. After 10,000 iterations, there were fewer than 50 piles left, with an average of 30 wood chips in each pile. And after 20,000 iterations, only 34 piles remained, with an average of 44 wood chips in each pile.

The process was slow and frustrating to watch, as termites often carried wood chips away from well-established piles. But it worked. And as we watched the termites on the screen, it became obvious why this simple strategy is effective. Whenever the termites remove all the wood chips from a particular spot, the pile never restarts, since termites drop chips only where others already reside. The termites might drag chips back and forth between piles, but once a pile is gone, it is gone forever. So the total number of piles keeps shrinking.

Some Guiding Principles

People are usually fascinated by such decentralized phenomena. But when they try to understand or create their own decentralized systems, they often slip back into centralized ways of thinking. Through my work with high-school students, I have developed several guidelines to help people make sense of decentralized systems, highlighting some pitfalls to avoid and some possibilities not to overlook. For example:

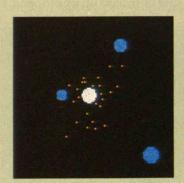
Positive feedback isn't always negative: Positive feedback is frequently symbolized by the screeching sound that results when a microphone is placed near a speaker. It is usually viewed as destructive because the situation often spirals out of control. By contrast, negative feedback is often symbolized by a thermostat that keeps room temperature at a desired level by turning the heater on and off as needed. It is thus considered useful because it keeps conditions under control. When I asked high-school students about positive feedback, most were unfamiliar with the term. But when I explained what it

meant, the students quickly generated examples, most of which involved a loss of control, often with destructive consequences. One student talked about scratching a mosquito bite, which made the bite itch even more, so she scratched it some more, which made it itch even more. Another student talked about stock-market crashes: a few people start selling, which makes more people start selling, and so on.

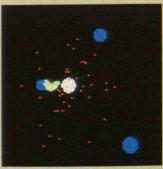
Despite these negative connotations, positive feed-back often plays a positive role in decentralized phenomena. Brian Arthur, an economist at the Santa Fe Institute, points to the geographic distribution of cities and industries as an example of a self-organizing process driven by positive feedback. After a small nucleus of high-technology electronics companies started in Santa Clara County south of San Francisco, an infrastructure developed to serve the needs of those companies. That infrastructure encouraged even more electronics companies to locate in Santa Clara County, which encouraged the development of an even more robust infrastructure. And thus Silicon Valley was born.

Randomness can create order: Like positive feedback, randomness has a bad image. Most people think randomness simply makes things disorderly. They view randomness as annoying at best and destructive at worst. But randomness plays a crucial role in many self-organizing systems by creating fluctuations that act as natural seeds from which patterns and structures grow.

At concerts or sporting events, for example, spectators sometimes join together in seemingly spontaneous synchronized clapping. How do they coordinate their applause without a conductor? Initially, when everyone starts clapping, the applause is totally unorganized. Even people clapping at the same tempo are wildly out of phase with one another. But through some random fluctuation, a small subset of people happen to clap at the same tempo, in phase with one another. That rhythm stands out, just a little. People in the audience sense this emerging rhythm and adjust their own clapping to join



ANTS (ORANGE DOTS) WANDER RANDOMLY FROM THEIR NEST (WHITE) TO FIND FOOD (BLUE).



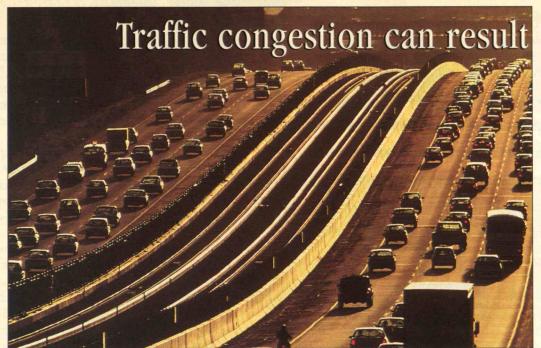
ANTS FIND CLOSEST FOOD, THEN
LEAVE A PHEROMONE TRAIL
(GREEN) AS THEY RETURN TO NEST.



AS FOOD NEAREST THE NEST DWINDLES, ANTS LOCATE THE NEXT CLOSEST FOOD SOURCE.



PHEROMONE TRAIL TO DEPLETED FOOD SOURCE EVAPORATES. PATH TO SECOND SOURCE WIDENS.



from random

interactions among individual vehicles, even in the absence of impediments such as an accident, a radar trap, or hordes of rush-hour commuters.

it. The emerging rhythm thus grows stronger and even more people conform to it. Eventually, nearly everyone in the audience is clapping in a synchronized rhythm. Amazingly, the whole process takes just a few seconds, even with thousands of people participating.

A traffic jam isn't just a collection of cars: It is fair to think of most objects as a collection of particular parts. For example, a particular chair might have four particular legs, a particular seat, and a particular back. But this is not so with objects like the termite wood-chip piles. The composition of the piles is always changing, as termites take away some wood chips and add other wood chips. After a while, few if any of the original wood chips might be in the pile, but the pile is still there. The wood-chip pile is thus an example of an "emergent object"—it emerges from interactions among lower-level objects. Similarly, a traffic jam is an emergent object, continuing to exist even though the com-

position of cars within it is always changing.

Students often have difficulty thinking about emergent objects. For example, two students, Frank and Ramesh, tried to use StarLogo to simulate an ant cemetery, in which ants gather their dead colleagues into neat piles. This problem was virtually identical to that of programming termites to create wood-chip piles. But Frank and Ramesh resisted the simple decentralized approach that Callie used for the termites. They were adamant that dead ants should never be taken from a cemetery once placed there. How can a cemetery grow, they argued, if the dead ants in it are continually being taken away? With this strategy, however, Frank and Ramesh ended up with lots of little cemeteries rather than a few big ones, simply because a cemetery, once started, could never disappear. If Frank and Ramesh had viewed the cemetery as an emergent object and allowed the composition of ant cemeteries to vary with



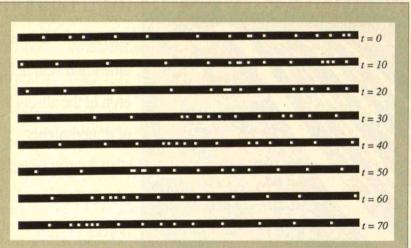
RAIL TO THE MOST DISTANT FOOD BEGINS TO FORM AS THE SECOND FOOD SOURCE DISAPPEARS.



AS THE LAST LOCAL FOOD SOURCE IS DEPLETED, THE ANTS CONTINUE THEIR RANDOM FORAGING.

This simulation shows how ants seem to use a sophisticated foraging strategy—gathering food closest to the nest first and that farthest from the nest last. In fact, each ant follows a few basic rules: If an ant finds food, it leaves a

pheromone scent as it walks back to the nest. If other ants sense the pheromone, they follow it to the food, thereby reinforcing the trail. When a food source is depleted, ants no longer drop pheromone, and the trail quickly evaporates.



Traffic congestion can occur without obvious impediments, as this simulation illustrates. Each car (white dot)—shown as it travels from left to right—follows two rules: If it sees a car close ahead, it slows down. If not, it speeds up. As time elapses, jams

appear (and move right to left) because whenever a few cars happen to converge, they slow down, causing the cars behind them to slow down as well. A jam would not occur if all cars were evenly spaced and traveling at exactly the same speed.

time, they would have had much greater success in creating large ant cemeteries.

The hills are alive: In his book Sciences of the Artificial, Herbert Simon, a Nobel laureate economist from Carnegie Mellon, describes a scene in which an ant is walking on a beach. Simon notes that the ant's path might be quite complex, but it does not necessarily reflect the complexity of the ant. Rather, it might reflect the complexity of the beach. Simon's point: don't underestimate the role of the environment in influencing and constraining behavior.

Many people seem to resist the idea of an active and influential environment. For example, when I told a student about a StarLogo program in which ants find food by following pheromone trails, he was worried that the trails would continue to attract ants even after the food source at the end of the trail had been fully depleted. In his mind, the ants had to take some positive action to get rid of the pheromone. In fact, he proposed an elaborate scheme in which the ants, after collecting all of the food, deposited a second pheromone to neutralize the first pheromone. It didn't occur to him that the first pheromone would simply evaporate away.

Foundation for Discovery

A friend of mine has a daughter named Rachel. By the time she was three years old, Rachel had already devel-

oped a theory about why it rains on some days and not on others. "The clouds rain when the thunder tells them to rain," she explained. In her mind, some type of centralized decision making was necessary. Thunder commanded, and the clouds obeyed.

It is not surprising that Rachel came up with a centralized explanation for the rain. Most likely, she was unaware that other types of explanations even existed. But as Rachel grows up, will she continue to rely on centralized explanations? If she takes a physics course in high school, will she understand gravity as two objects pulling on one another with equal force, or will she think of gravity as a one-way force, with one large object pulling on a smaller one? If she takes an economics course in college. will she understand that interests rates and money supply can affect each other, or will she assume that one is the cause and the other is the effect? If the unemployment rate rises dramatically, will she search for explanations with multiple, interacting causes, or will she immediately assume some type of evil conspiracy?

An elementary or high-school course that teaches Ten Golden Rules of Decentralized Thinking probably would not have much effect on someone with a firmly entrenched centralized mindset. Young students are likely to become comfortable with decentralized ideas only if they get opportunities to design, create, explore,

and play with decentralized systems.

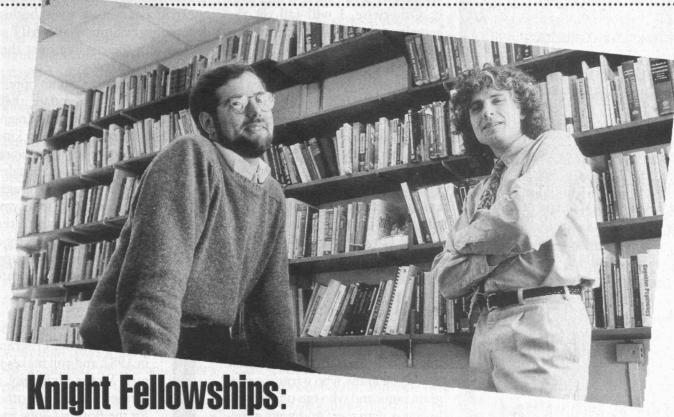
What's needed are computer-based construction kits that let children like Rachel create their own decentralized microworlds. At school, Rachel might create an artificial environment with giraffes, elephants, and her other favorite animals and program each to follow a few simple rules. She could then observe what patterns emerge from the interactions and how simple changes can affect the entire ecosystem. At home, she and her friends might simulate how people gather into groups at a party. By working on projects like these, Rachel could come to understand the importance of decentralized ideas in explaining the world around her.

By the time Rachel was four, she had developed a new theory about the rain. "The clouds get together at night, and they decide whether it should rain the next day," she explained. This new theory still involves some centralized planning, but there was no longer a central actor, the thunder, in charge of the whole process. If Rachel is surrounded by new types of computational tools and ideas as she grows, one can only wonder what new theories she'll develop to explain the rain.

VITIEWS

FROM THE ASSOCIATION OF ALUMNI AND ALUMNAE OF MIT

JULY 1994



Time to Change Gears BY STEVEN DICKMAN

t sounded like a prize you would win on a game show: an all-expensespaid year as a sciencejournalist-in-residence at MIT, the only required activities being regular few cocktail parties. When I received a Knight Science Journalism Fellowship at MIT for the academic year 1992-93, my friends were incredulous. How silly could an institution be, they asked, to bring in journalists and then not even ask them to write? Besides the lucky journal-

ists, who could possibly benefit?

would win on a game show: an all-expenses-paid year as a science-journalist-in-residence at MIT, the only required activities being regular seminars on science and a scocktail parties. When I and the scocktail parties are substantial.

But I found out that a Knight Fellowship, supported by a grant from the John S. and James L. Knight Foundation of Miami, Fla., is anything but a nine-month free ride. And the benefits—not only to the journalists but to society, and ultimately to MIT itself—are substantial.

Journalism is a profession of local experts. The demand for fresh copy is so great, and the time in which to produce it so limited, that journalists have to rely on sources they know well. As a result, they become typeSteve Dickman (left) a 1992–93 Knight Fellow, found that working with MIT brain and cognitive sciences professor Steven Pinker is a career-altering adventure.

cast even more quickly than soap-opera actors. The best publications—the *New York Times*, for instance—rotate their people through different geographic or intellectual beats. The man in Buenos Aires moves to Budapest; the woman covering the airlines switches to telecommunications. But 99 percent of media organizations cannot afford such

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He Will Be Sorely Missed

Writing the obituary of Constantine Simonides, '57, MIT's dynamic vice-president in the office of the president, was a particularly painful task. He died too suddenly, and much too soon. I knew him well enough to see that he was tackling the tremendous task of reengineering the Institute with the same zest he had shown in taking on the U.S. Justice Department. He would quiz me and other campus communicators about how to present the progress of reengineering so that the entire community felt involved. He never neglected the human factor. As the campus continues to rethink what MIT is all about. his wisdom and warmth will be sorely missed.—SUSAN LEWIS

Knight Fellowships: Time to Change Gears

continued

extravagance. And for a freelance journalist like myself, the situation is even more dire. To publish articles on a certain subject, I had better already know quite a lot about it. Otherwise, I will fall off the learning curve and into a professional and financial abyss.

In science journalism, this is a particularly grave problem. It takes a lot of time and effort to switch from nanotechnology to neuroscience or vice versa-time enough for a journalist to starve if someone isn't supporting this intellectual adventure. But I would argue that precisely this kind of lateral movement is desirable and useful for both journalists and society. For one thing, there is what I call the "Croatian opera factor." As a Yugoslav journalist based in Bonn once told me, you can cover the opera in Zagreb for only so long. Stagnation and complacency begin to set in. After a while, you not only know who performs best in what role—you know who wrote the program notes and who ran off with the business manager. And your material, no longer infused with your personal thrill of discovery, begins to grow stale. If science journalists lose their edge, it's more than a personal idiosyncrasy: At both newspapers and magazines, science coverage already has a difficult time competing against war and politics, not to mention the latest scandal at the Olympics. As journalists becomed bored or narrow, the writing becomes routine and inbred-quality drops. This scenario may have contributed to the fact that the number of daily newspapers publishing a weekly science section has dropped from 95 in 1989 to just 47 in 1992, according to the Scientists' Institute for Public Information in New York. And when periodicals and newspapers focus less on science, it is reasonable to expect that young people may be less motivated to choose science as a career and the government less inclined to provide funding for research; a dangerous spiral begins, threatening institutions like MIT as well as any society like ours that depends on technology.

By allowing journalists an opportunity to extend or update their interests in certain fields, the Knight Fellowships help to combat that kind of intellectual erosion. By stimulating the fellows to provide more thoughtful and balanced science coverage, the fellowships contribute to a sympathetic atmosphere in which the MITs of the world at least receive a hearing before their legislators and the public decide how to allocate resources.

he man who launched the Knight Fellows Program in 1982 and still makes it go is Victor McElheny, a former science reporter for the Boston Globe and the New York Times. He sets up the seminars that form the core of the program and serves as an invaluable resource in advising fellows on how to break out of their type-cast roles. Every year, McElheny assembles a panel of established media professionals to vet applications for fellowships from about 30 print and broadcast journalists. The panel interviews 15 candidates, and from them chooses the 8 fellows.

I believe that some aspects of my own year at MIT illustrate the way a Knight Fellowship allows journalists to leap over the limitations that lock them into specific beats. I came into the fellowship with two broad specialties: biomedical science and international science policy. Although my year at MIT allowed me to enhance my knowledge in each of these areas, I also managed to branch into an entirely new area: historical linguistics, in which scholars try to understand the evolution of human languages and to create a tree of languages reaching back tens of thousands of years.

I am far from the only such example. Take Don Lessem, who used a 1987-88 fellowship to become one of the leading writers on dinosaurs in the United States, with four published books on the subject and three more in press. Or William Booth, who came to MIT in 1986 as a freelancer from Texas and landed a job with Science magazine when his fellowship ended. (Booth is now Miami bureau chief for the Washington Post.) The program even plays a comparable role for a number of foreign fellows each year. Unlike U.S. citizens, fellows from outside this country come with their own funding and are admitted on a case-by-case basis—there were six in 1992-93, from countries as diverse as Poland, Italy, and Australia. Thomas Müller of Switzerland, for example, covered biology for a newspaper in Basel before coming to Cambridge, and he took courses in physics and astronomy at MIT and at Harvard. He even worked for two months searching for gravitational lenses in the astronomy laboratory of Jacqueline Hewitt, Class of 1948 Assistant Professor of Physics at MIT. Thus it came as no surprise when Müller recently was offered a job writing about the physical sciences for one of the most respected dailies in Switzerland.

The fellowship offers journalists

two main advantages: First, it frees us from deadline pressures. As a correspondent for the weekly British science journal *Nature*, I wrote two articles a week for nearly five years. Some of my colleagues at daily newspapers produce two articles every day, on subjects as diverse as ozone holes and magnetic resonance imaging. Clearly, under pressure like this, it is hard for us to see the big picture, let alone jump fields.

any of the fellows, myself included, responded
to this release from
deadline pressure by
doing the only thing
our workaholic natures
allowed: working harder.
Before and after our
twice-weekly seminars
with MIT faculty and

ing variety of subjects, we took classes, attended public lectures, and read stacks of books. Some classes, such as an MIT graduate seminar on the history of epidemics, attracted three Knight Fellows and no regular graduate students.

researchers on a dizzy-

Second, the fellowship provides access. The best way to get to talk to a scientist is to demonstrate that you have some familiarity with his or her work—something you can't accomplish merely by showing up at a 30-minute press conference when results are announced. What better way to become familiar with a scientist's oeuvre than to attend a class or lecture? And what better way than by asking an expert can one begin to sort out the important debates within a scientific field from the superficial spats?

During Independent Activities Period last year, I attended two lectures by Steven Pinker, a professor of brain and cognitive sciences whose most recent activity includes a controversial cover story in the January 31 issue of the *New Republic* magazine criticizing William Safire and other "language mavens." The article was from his new book, *The Language Instinct*, which also attracted a lot of attention when it was published in February.

After I had heard his lectures, approaching Pinker was straightforward, and we developed a working relationship that has been instrumental in making linguistics a more solid addition to my journalistic repertoire. A few months after my Knight Fellowship ended, Helix, an international English-language magazine published in the Netherlands, called to ask me to do a piece on the link between linguistics and population genetics. That "link" was news to me, but within minutes of calling Pinker, I not only had an outline of where to look up the most important work, but also Pinker's opinions about whose work is the most reliable. His counsel enabled me to firm up my assignment from Helix and helped me land a later assignment on historical linguistics from Science magazine.

Now that I have begun to establish a small reputation for myself in this area, I fully expect several years' fruitful work, possibly including articles about Pinker's own research. Every Knight Fellow can tell a unique but comparable story.

By taking eight U.S. science journalists a year and opening wide the doors of the Institute to them, MIT is gradually transforming this country's science journalism into a more vibrant, more readable, and ultimately more influential field, to the ultimate advantage of society at large and MIT itself.

Learning in a Research University

By President Charles M. Vest

n the spring issue of the MIT Parents' News, President Vest addressed this letter to the families of students, outlining his perspective on the value of undergraduate study at a great research university. At least in part, he was responding to allegations that students are shortchanged by research-oriented faculty, and he wanted to reassure parents who may be concerned. The editors of Technology Review thought that alumni/ae also would appreciate reading the president's cogent statement on the ultimate value of keeping research and teaching closely intertwined.

By selecting MIT, your sons and daughters have chosen to continue their education at a research university, a community that is home to undergraduate and graduate education, as well as to the search for new discoveries about the world we live in. Over the past 40 years, these institutions have served

America exceedingly well:
educating leaders in academia, business, and government; advancing our skills in endeavors as diverse as music and the arts, technology, medicine, and industrial development; and deepening our understanding of our physical, social, and natural worlds.

In today's debate on undergraduate education, however, the value of the undergraduate instruction that such an institution offers is being called into question. What the question assumes is that research and teaching are somehow incompatible. The professors at a research university are devoted to their research, the argument runs. It is for their research that they are judged and rewarded—their teaching is, at best, a secondary obligation.

There are many legitimate concerns about the quality of education in the United States that must be addressed, but posing the issue as a conflict between teaching and research misses the point. As parents of MIT undergraduates, you should know why we believe the education and experience in which they are engaged are vital both for them and for this country's future. The real issue is how to maximize the quality of undergraduate education by drawing on the resources and experiences that are uniquely available in research universities. At the heart of the discussion, I think, is the understanding of the nature of research and education.

For nearly 20 years, I was active in both classroom instruction and research, teaching both undergraduate and graduate subjects every term. As a teacher, I have seen the value to students of learning from—and

working with—men and women who are discovering the future through their research, not just teaching the history of their fields.

he object of research, to paraphrase Nobel Prize-winning physicist Leon Cooper, is to discover how the world works. We use research both to satisfy our innate curiosity (what is the structure of the solar system, what are the basic constituents of matter, and how do they interact) and to help us solve problems (how can we prevent and cure disease, create more livable cities, or secure the advances of computers and communications technology for the social good). Sometimes, what we learn by satisfying our curiosity turns out to produce knowledge we can use to solve our problems.

The object of education, broadly speaking, is to prepare people to live full and responsible lives. The students who come to MIT are people who have their own agendas. Among them are individuals with a passion to engineer a better world and to shape the future. Among them are profoundly creative people who will tread new and different pathways in science and engineering, as well as in the arts, humanities, management, and social sciences. Among them are those who will design new buildings and create more humane urban living environments. Our society will ask much more of these students-and they will ask more of themselves-than merely to know what others have accomplished. If they are going to help us expand our knowledge and solve our problems, they will require the ability to investigate, to analyze, to synthesize, and to communicate.

MITnews

They must learn how to gather data; how to develop, test, and refine hypotheses; and when to throw out hypotheses and start again. They also will need experience sharing their work with other professionals and with their fellow citizens.

ost of what we teach our students in the core science subjects at MIT—in mathematics, physics, chemistry, and now biology-provides a basic understanding of how systems work and how processes can be expressed mathematically. The core subjects also give students an understanding of how fundamental concepts are developed and used. Establishing this foundation is critical. and students must have good teachers to guide and inspire them. Some of these subjects take the students amazingly close to the frontiers of human knowledge, imbuing them with the spirit of intellectual adventure. This adventure is present in the humanities, arts, and social sciences as well: students work with faculty who are not only musicologists but major composers; who are not only observers of, but players in

At MIT, the faculty—including the most renowned—are as serious about their teaching as they are about their research. They continually renew the undergraduate curriculum as the intellectual map changes and the

the government scene; who not only critique best-sell-

ing books, but write them

as well.

world in which we live evolves and transforms. Because they are so deeply engaged in intellectual and technological progress, the faculty have a grasp of the preparation our students will need. Our new undergraduate biology requirement, which took effect with this year's freshman class, is an excellent example: The revolution in molecular and cell biology of the last few decades, led in part by MIT scientists, will touch all of us

through its effects on medicine, the environment, and biotechnology. Genetic counseling and genetic engineering will be a part of all of our lives. To be scientifically literate, therefore, today's students must understand the intellectual basis of these developments and their social implications. MIT is the first university in the country to acknowledge this scientific revolution by adding molecular biology as a required subject for all undergraduate students—

but one instance among many in



Learning in a Research University

Continued

newly formed theory or newly discovered phenomenon into the

classroom to give students the opportunity to work with it, challenge it, refine it, or extend it.

A unique and unusually effective part of the MIT undergraduate experience is the Undergraduate Research Opportunities Program (UROP), which is specifically designed to put students on the front lines of research. At least three-quarters of undergraduates take part in UROP while they are here, projects that range from one-onone, faculty-student collaborations to research teams with faculty, graduate students, and other undergraduates that reflect the increased interdisciplinary nature of much of today's frontier research. These experiences, ranging from developing computer models of the evolution of the universe to designing robotic fish, deepen understanding, give reality to theory, develop relevance and excitement, and personalize education.

I believe that where there are problems with undergraduate education in this country, it is more often because of a *separation* of teaching and research. The discipline, joy, and continual renewal of original research, scholarship, or other creative intellectual activity keeps teachers lively and successful. One may start out as an effective and even brilliant teacher, but without the kind of continual renewal that research and scholarship provide, one may not grow in wisdom and breadth, and over time may lose rather than gain in effectiveness as a teacher.

This is an issue that I often discuss with members of Congress and federal policy makers, because government support of education and

There is tremendous value in learning from men and women who are discovering the future, not just teaching the

history of their fields.

research is critical to our future. Indeed, I believe a very serious threat to our faculty's commitment to teaching is the increasing difficulty in finding funding for research and graduate-student support, as research dollars shrink and merit and peer review give way to porkbarrel politics. The surest way to dampen our faculty's teaching, and our students' learning, would be to

cut research budgets, thereby increasing the already substantial time that faculty must devote to proposal writing and administration. At the end of April, three of our UROP students went to Washington to urge senior staff members in Congressional and White House offices to maintain the federal commitment to the policies and practices that have helped us keep the UROP program strong. (There will be a report on this creative student lobbying effort in the August/September issue of MITnews.)

Enabling our students to reach their full potential as players in our society and, just as importantly, as players in the beauty and the adventure of creating and understanding, requires that we teach them how to advance our knowledge. That is why I believe that the very best learning environment is one in which undergraduate and graduate education are blended with the conduct of research and scholarship. The issue should not be teaching versus research, it should be the proper interweaving of the two. I am fond of quoting the late Fred Terman, ScD '24, who served with great distinction as Stanford's engineering dean and later as provost. When asked once whether he wanted his university to be a teaching institution or a research institution, he answered that he wanted it to be a learning institution. And that is the ideal-students and faculty learning together in both the classroom and laboratory.

LETTERS

OVERLAP FIGHT A MODEL FOR LIFE

do like the new look of MITnews, though it somehow feels less personable. Maybe it's the fact that it doesn't have a "cover"—it jumps right into an in-depth article.

But what an article it was —"MIT and the Overlap Suit: The Side of the Angels" (TR, April 1994). Susan Lewis wrote a clear synopsis of the events that I appreciate. Her account of the suit moved me: I am grateful for MIT's dedication to putting principle ahead of monetary considerations. I am proud to have gone to MIT, and my resolve to put principle ahead of money in my own life is strengthened.

Congratulations to Charles Vest and all the others who stuck it out.

DAVID ABRAMSKY, '84 Thunder Bay, Canada

TIME FOR A HUMANITARIAN-TECHNOLOGIST

The editor's First Line, "Respecting the Instrument" (*TR April 1994*), is first rate. It should be copied and put in the hands, if not the minds, of every entering freshman and graduate student at the Institute and elsewhere, to acquaint them with the root moral and ethical principles that must underlie all of their work in science and technology.

The Institute is still young, relatively speaking, despite the enormous technologic contributions of its graduates and faculty in times of war and of peace. However, MIT really will have arrived when we can point to a great humanitarian-technologist alumnus or alumna of the

Dance Club (BDC) celebrated its 20th anniversary with, appropriately enough, a ball, on April 23. MIT has long been famous for its alum dancers, many of whom returned for the event. (Of the 300 who attended the ball, more than half were MIT affiliated.) Pictured clockwise from the top: 1 MIT graduate student Diego Diaz, BDC president; Tina Parpadopoulos, BDC VP; and Daniel Radler, '79. Radler, who has a full-sized dance floor in the basement of his home, was featured for the eighth year as a finalist in the PBS show Championship Ballroom Dancing. He and his partner gave up more conventional careers for the love of ballroom dancing and over 15 years have amassed many titles, including

North American Champions and U. S. Champions. They are currently the number-two-ranked amateur couple in the United States.

Walker Memorial comes alive with a swing number. Dramatic dance partners Allyn Garvin (left) and Ron Gorsky. Gorsky, the first ballroom dance teacher in MIT's Athletic Department, is considered the mentor of area ballroom dancers. The BDC maintains a 24-hour information line (617-258-6554).

Letters

stature of Albert Schweitzer, and when our engineering is based on a profound respect for "carbon-based units" (that is, human beings).

A little of "the Buchenwald touch"? No, never, never again!

WILLIAM J. CAVANAUGH, '51 Natick, Mass.

TR'S FOCUS ON WOMEN'S HEALTH IS PART OF A LONG TRADITION

very much enjoyed the February/
March "First Line," in which editor Steven Marcus noted that the
article in that issue on women's
health as a medical speciality is but
the latest in a number of articles
about women presented by *Technol-*ogy *Review*. Aware that some readers might comment on the frequency
of such articles, Mr. Marcus offers
the reasons behind the editorial
choices—reasons that are quite correct, in my view.

I enrolled at MIT more than 50

years ago, in 1943, and earned a PhD in economics in 1946. As a woman graduate of an older generation, I can say that the Institute's receptivity to women has long been one of its distinguishing qualities. It's an unusual quality, of which the general public, and perhaps many close to MIT, are not sufficiently aware.

As a student long before the women's movement of the last two decades, I was always given equal treatment by my professors and my fellow students. There was not a murmur of surprise at my presence. (I did not find the same acceptance at that eminent university further up Massachussetts Avenue.)

In the 1940s, I found it a source of inspiration to see hanging in the corridors photographs of women graduates and faculty from MIT's very early years. It was a particular thrill for me, on a visit to campus last year, to come upon the Ellen Swal-

low Richards Lobby at the corner of Buildings 2 and 4, dedicated to MIT's first woman graduate (Class of 1873) and member of the instructional staff.

I attend meetings of the MIT Club of Washington, D.C., where I have lived and worked professionally since 1946. As a "gray-haired lady," I stand out among the younger males who make up the majority of the club membership, but I still experience the same easy acceptance and equal treatment among fellow alumni that I did as a student.

When it comes to the subject of women, MIT has always been light years ahead of its time. *Technology Review's* series of articles focusing on issues of particular concern to women is thus in keeping with tradition at this unique institution of learning.

MARGARET GARRITSEN DE VRIES, PhD '46 Bethesda, Md.



Maybe you weren't there for the screening of Mr. Deeds Goes to Town on May 2, 1950, but the odds are that sometime during your MIT days, you attended a Lecture Series Committee (LSC) event. Known mostly for their outstanding movies (1,113 peo-

ple saw *The Piano* through LSC last fall), the committee has also sponsored the presentations by Robert Frost (1952), Henry Kissinger (1958), and "Dilbert" cartoonist Scott Adams (1993). Doc Edgerton, '27, gave regular LSC lectures. LSC celebrates its 50th anniversary on September 17, 1994. A statistic reminiscent of MacDonalds, LSC claims to have served more than 2.6 million people over the past half-century. That's a lot of popcorn! As part of their anniversary celebration, organizers are contemplating dropping the current \$2 ticket charge to 1950 prices: 30 cents. LSC members or other alumni/ae interested in participating in or attending the anniversary should contact Patrick Mahoney at 617-253-3791, e-mail at <lsc@mit.edu>.

erving as president of the Association of Alumni and Alumnae of MIT isn't such a bad job. Among the nice things are visiting with the clubs, where I meet some wonderful people, break bread with them, and chat about what's happening in Cambridge.

But it's not entirely a rose garden, and can sometimes lead to awkward situations. For example, a young alumnus stood up at a meeting in early January, waving a newspaper article from the Washington Post. "This says MIT scientists conduct experiments on unknowing retarded children and pregnant mothers." Then, waving another article, he added, "And this one says, 'Cheating is out of control and a way of life among MIT students.' What are you going to do about it?"

Now, I certainly don't blame this young man for raising these issues, any more than I blame the *Washington Post* for trying to sell newspapers. They both have every right. But I was embarrassed because I didn't have the answers.

Needless to say, I later looked into both issues. For those alumni or alumnae who also are not up to date, let me summarize, starting with the question of research subjects: In the 1950s, the federal government, fearful of the nuclear threat and concerned about radiation in space, undertook a number of experiments wherein individuals allegedly were exposed to dangerous levels of radiation and were not informed of the nature of the tests nor the potential consequences.

During the same general time period, scientists at MIT were studying the way the human body absorbs dietary iron and calcium, generating knowledge that would be helpful, for A LETTER FROM RICHARD A. JACOBS, '56





example, in treating osteoporosis. The test subjects were students at the Fernald School for retarded children in Waltham, Mass., where a participating scientist held a clinical post. Small doses of radioactive isotopes not unlike those still used in standard medical tests such as scans of the upper and lower gastrointestinal tract—were administered to help measure the rate of absorption. The radiation to which the test subjects were exposed was a fraction of the doses deemed "safe" even by current standards, which are far lower than doses considered acceptable at the time. There was no connection, in goals or effect, between the federal radiation studies and the MIT nutritional investigations, but because they overlapped in time and involved both sensitive test subjects and radioactive materials, the research enterprises were routinely lumped together in a rash of media reports during the winter.

Although the focus on the old study has been painful for MIT, no one denies that the test population was a poor choice by today's ethical standards, nor that MIT did not document the consent of participants. (At the time, the requirement to obtain the consent of the participating individuals or their guardians applied only to the doctors in contact with subjects, not to the sponsoring university.)

An aspect of this case that has not received any media attention, however, is the fact that it was their very experience as active researchers that enabled MIT scientists to contribute to safer standards of exposure for human subjects. MIT led the way among research universities in establishing in the early 1960s its own set of standards and review procedures,

Jacobs Letter

continued

which 30 years of advancing knowledge have not rendered obsolete. MIT people also worked with the World Health Congress in Helsinki to set safe exposure levels for radiation and establish more stringent practices regarding informed consent—eight years before these guidelines were generally adopted in this country.

I think that learning from past mistakes in order to craft a better way for the future is an MIT hallmark. I'm not alone in this conviction.

he "cheating" case, on the surface, appears far removed from real or suspected exploitation of medical-research subjects. To recap the facts: in spring 1990, the teaching cadre of a computer-programming class offered in the Department of Civil and Environmental Engineering brought nearly 80 students up before the Committee on Discipline for copying each other's assign-Now, "collaboration" ments. among students is not unusual—in fact, many MIT professors and teaching assistants encourage undergraduates to practice "teaming" and working together because it is a way of life in the professional world. The problem is, where does teaming stop. and outright copying begin? In this particular case, most of the students were found guilty of cheating to some degree, and a variety of penalties, from a reprimand to one-year suspension, were meted out.

The incident triggered another rash of negative publicity, but again, MIT attempted to turn a wrong into a better way for tomorrow. The effort was guided by what Arthur Smith, dean for undergraduate education and student affairs, refers to as "MIT's concrete concern for the

individual," and its belief that "behavior can change, recurrence can be prevented."

Two years ago, the Institute launched a response to its apparent cheating problem with an in-depth survey among students and faculty to understand actual practices. Among the findings: 11 percent of students reported they had cheated at least once on a test or exam. Although this is a lower percentage than was found at 31 schools in a similar survey conducted by another university, that figure afforded little comfort.

In fact, MIT showed no inclination to tolerate cheating just because it seems to be widespread. Responding to the Washington Post article, President Charles Vest noted that the MIT student completes the most rigorous undergraduate curriculum in the nation, if not the world. "So shouldn't we be a bit more understanding when our students cut an ethical corner or two because of the pace and pressure of their studies? After all, it is the 1990s," Vest wrote. "The answer is the same today as it was when MIT was founded in 1861," he continued. "Absolutely not."

rmed with information from its study, MIT is acting: Student representatives serve with faculty on committees that focus on behavior and attitudes and then work to develop more effective practices in such areas as monitoring exams and problem sets. Institute-wide discussions are ongoing.

Significantly, the Committee on Discipline has reinstated its earlier practice of issuing annual statistical reports on the resolution of cases brought before it. Although the resolution of individual cases is always confidential, the publication of summary statistics gives the community at large, and students in particular, clear indication that cheating has serious consequences. All of these actions are a beginning.

rankly, many things bother me about these two situations-or for that matter, any moral or ethical issues at the Institute. First, I'm embarrassed when I read or hear unfavorable reports about MIT in a newspaper or other media. It tarnishes my pride in the school and the esteem in which I hold it. I have very high expectations for MIT, and I certainly expect that it will learn from its mistakes to develop positive solutions for the future. But I sometimes chafe at the slow pace of progress on issues of integrity at MIT and other academic institutions. I find myself arguing that they could move faster without sacrificing quality of outcomes if they just assigned a higher priority to ethics.

I also get angry. Angry at the reports that sensationalize and don't even try to tell the whole story. Angry at finding myself pressed to defend events far in the past, events in which I and my classmates had no part.

I can't change the past or account for every action at a large institution. No one can. At best, I can continue to be a thoughtful observer of the frailties of MIT and other colleges and universities. Like many alumni and alumnae, I can use every opportunity to quiz my campus contacts about why things happen and what MIT is doing about it. As I mature with age, perhaps I will get angry only if the same mistakes are repeated—and maybe a little "nagging" from alumni/ae can help avoid any chance of that happening. □

1934-1994

CONSTANTINE B. SIMONIDES, '57

Bidding Farewell to a Dear Friend

n April 29, hundreds of members of the MIT community joined the family, friends, and Wellesley neighbors of Constantine B. Simonides for his funeral—honoring a man with whom, they discovered, all of them felt they had a special relationship.

For everyone who knew this energetic and vital man, the news of Simonides' death at age 59, of a heart arrhythmia while playing tennis, was a tremendous shock. Many recognized how many activities he supervised and could imagine how difficult it will be for the Institute administration to abruptly reallocate his responsibilities elsewhere.

Simonides had been a vicepresident in the office of the president for 24 years; since 1984 he had also filled the post of secretary to the MIT Corporation; and for more than four years he directed MIT's successful battle with the U.S. Department of Justice over financial aid practices. Because his responsibilities included personnel, the medical department, public relations, admissions, athletics, career services, and the



CONSTANTINE B. SIMONIDES, '57

MIT Press, his work had a substantial impact on students, faculty, staff, and people off campus who are interested in news of the Institute. His death was an "incalculable loss" to MIT, said President Charles Vest.

Those who worked with him knew, what's more, that he was supportive to colleagues and subordinates. that he challenged them and was quick to issue accolades for work done well. What became most clear at the funeral, however, through emotional eulogies by his old MIT classmates, his three adult children, and a colleague of 30 years, was that he extended bound-

less, curious, nurturing warmth to just about everyone he met, from new members of the Corporation to his dry cleaners.

Born in Athens, Greece, Simonides came to the United States at age 17 to finish high school at Saint Andrew's School in Middletown, Del., on an American Field Service International Scholarship. He studied for three years at MIT (where he was known as Gus by his classmates) and received a bachelor's degree in economics from Boston University and

He began a series of administrative posts in MIT's Sloan School of Management in 1960. From 1966 to 1970. Simonides was assistant to President Howard Johnson, and in 1970, Johnson appointed him vice-president. In 1985, Simonides was elected secretary and ex-officio member of the MIT Corporation.

an MBA from Harvard.

President Vest said that "through the force of his ebullient personality and

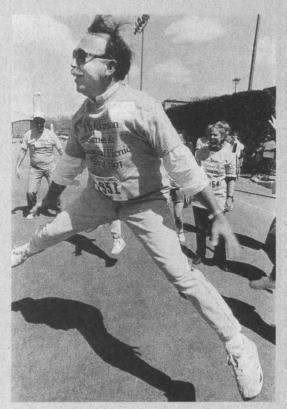
CONSTANTINE B. SIMONIDES, '57

Continued from page MIT 11

through the boundless energy he applied to everything he did. [Simonides] made MIT a happy, satisfying place to work. His near-photographic memory regarding facts and happenings was legendary and a great asset in the conduct of his duties. Still, his greatest talent was a never-ending fascination with and insight into people."

Simonides demonstrated that fascination in his marathon interviews with prospective employees, remembered Kathryn Willmore, who began working with him in 1964. Applicants

would arrive at Constantine's office as strangers, said Willmore at the funeral, "and after two, or sometimes three hours, they would emerge, having told their entire life story and their basic, fundamental values to this person," who was, by the end, a friend. Those interviews were a manifestation of a characteristic also described by Richard Hill, who spoke at a campus awards ceremony of his year and a half as MIT's director of athletics, with Simonides as his mentor. In speaking of team building, Hill remem-



Constantine Simonides' spirit, energy, and enthusiasm for all things connected with MIT came through, as always, in his participation in the Iohnson Games, held in 1991 to celebrate the inauguration of President Charles Vest.

bers, Simonides urged the staff to "ask not how I am doing, but what have I learned."

"He believed MIT could become a better place for study and work-a greater contributor to education and research-and he saw it as his reponsibility to help lift this special place to higher levels of performance," remembered Paul Grav. '54, chair of the Corporation. "We were colleagues for nearly 30 years, and I relied on him for advice and counsel, for sound judgment, for his Hellenic optimism and humor, and for a sustaining

friendship," Gray said. Simonides' survivors include his wife, the former Betty Lane Allen of Belmont, whom he married in 1956, and their children, Ted, Philip, and Cynthia. A memorial service was held in Kresge Auditorium on

May 16.

Kathryn Willmore remarked of him that "creating and sustaining family, building community, is important work. You can't hold it in your hand, but you can carry it in your heart. And the people who do this are magicians." Constantine was ours.—Susan Lewis

ClassNotes

Please send news for this column to:
Miss Joyce Brado, secretary
491 Davison Road, #9
Lockport, NY 14094

Please send news for this column to:
Bob O'Brien, secretary
25 Keith Road
Pocasset, MA 02559

Please send news for this column to:
Don Severance, secretary 29 Hampshire Road
Wellesley, MA 02181

Please send news for this column to: Class Notes Editor Technology Review 201 Vassar St.
Cambridge, MA 02139

We received a most thoughtful notice of the death of classmate Leon I. Snow in Westport, Mass., on February 14. The notice was sent by Wesley W. and Adele M. Teich, family

members. Leon would have been 97 years old this May. He suffered a slight stroke before Christmas that left him somewhat incapacitated in speech and mobility. We will miss him. I plan to write more about Leon in a later issue.

From the Alumni/ae Association comes notice of the death on December 22 of Leo A. Kelley in Corpus Christi, Tex. We also received a kind letter from George W. Kelley, Leo's nephew, notifiying us of his passing. Finally we received an equally thoughtful letter about Leo from Noemi R. Garcia, an administrative assistant at Citizens Bank in Corpus Christi. Leo was a close friend of our class, and I will have much to add in a future issue.

We received a notice from the Alumni/ae Association of the death of Edmund J. Flynn on December 26 in Lehighton, Pa. "Doc," as he was known, and his wife, Erma, were longtime friends of mine and my wife, Florence. We shared class reunions and corresponded. We shall miss Edmund. As with the other classmates here mentioned, we will have more to add in later copies of Technology Review.

And so it does not look like the Class of 1919 can attend another reunion in June 1994. On that occasion, if I myself am still living, I will be in my 100th year and will be wishing all who attend the reunion our sincere blessings.—Bill Langille, secretary, Box 144, Gladstone, NJ 07934, (908) 234-0690

75th Reunion
Please send news for this column to: Harold Bugbee, secretary, 313 Country Club
Heights, Woburn, MA 01801

Wives and daughters of '21 have enjoyed our reunions to the extent that a number of them formed close associations with one another and often include your secretary in greetings, especially at Christmas.

As a special tribute to all the ladies of '21, we asked Helen M. St. Laurent, wife of our late class president Raymond A. St. Laurent, chemical engineering, to preface these notes.

One of the friendliest persons we know, Helen took the opportunity to express delight at meeting MIT people in general and the lovely ladies of '21 in particular. She tells us she shares with her ancient teddy bear the joyful remembrances of happy times with '21 families and sends you best wishes for health and enjoyment. Helen adds that she is well and still living in the large house in Connecticut, with summers in the home in Maine. You can reach her at 47 Gerard St., Manchester, CT 06040.

Helga Lund Parsons, wife of the late James S. Parsons, business and engineering administration, sent regards for the holidays with a separate note: "With special thoughts of you and appreciation for your enduring devotion to the Class of '21." This active lady has long been a loyal and enthusiastic supporter of MIT and our class. She makes her home at 100 Glenview Place, No. 902, Naples, FL 33963.

Emma Lloyd, wife of the late Leon A. (Al) Lloyd, mechanical engineering, was so concerned about both families that she sent yearend letters to Sumner Hayward and your secretary for news. In a long phone conversation, she tells us she is well and still drives to see her younger daughter in Westwood, Mass., but flies to visit her elder daughter in Atlanta, and uses rail service for trips to her son's home in Virginia. Her family includes eight grands and five great-grandchildren with a pair of twin girls. Emma's address is 35 Spruce St., Westerly, RI 02891.

With sincere thanks we acknowledge receipt from Priscilla Crago, Sumner Hayward's daughter, of a detailed summary of the beautiful memorial services held for the late Elizabeth McCoy Hayward, Sumner's wife. We still have not read Betty's book on her McCoy family—the real McCoys—which is long out of print. The curious facts are that, through the computer network of U.S. libraries, our Brielle, N.J., librarians learned no copy is available in New Jersey and only three libraries, respectively in Kansas, Kentucky, and North Carolina, even have copies, all of

Century in the Works: Freese and Nichols Consulting Engineers, 1894-1994 tells the story of the engineering accomplishments of the late Simon W. Freese, '21, and his firm. The book records contributions to the urbanization of Texas beginning with the building of the first sanitary sewer for Fort Worth to stop raw waste from being discharged into the Trinity River, "a menace to health and an offense to the nostrils." The firm made its mark in the areas of water supply and waste treatment-pioneering an activated sludge process—and building highways, dams, and airports.

Simon Freese was known for his practical jokes as well as the design of the nation's first large dual-purpose reservoirs for water supply and flood control, multi-city water districts, and his landmark water study in 1952 to develop a comprehensive water policy for Texas. Shortly before his death in 1990 a new dam near Ballinger, Texas, was dedicated as the S. W. Freese Dam.

During the year before his death, Freese worked on the centennial history with coauthor Deborah Lightfoot Sizemore (publishers Texas A& M University Press).



SEWER BANQUET

which are in reference sections and not available off the premises! Betty earned her Simmons College degree in library science and for years was the East Orange, N.J., librarian.

Grateful thanks from all of us go to Mrs. Arthur G. Wakeman, wife of the late Arthur G. Wakeman, mechanical engineering, and to Mrs. Robert M. Felsenthal, wife of the late Robert M. Felsenthal, chemical engineering, for their generosity in recent memorial gifts to our beloved alma matter in support of scholarship and unrestricted funds.

Sumner Hayward sent us a year-end letter from Celia H. Huggins, wife of the late Frank E. Huggins, chemical engineering, and an aerial view of her new island home in Shell Point Village, 2628 King Crown Court, Fort Myers, FL 33908-1650. It looks and sounds as though Ceil has a delightful spot to enjoy a variety of activities in comfortable and interesting surroundings.

We urgently need letters, postal cards, or phone calls from classmates or family members so as to maintain this column. Send a message to your secretary today.—Carole A. (Cac) Clarke, president and secretary, 608 Union Lane, Brielle, NJ 08730-1423, (908) 528-8881; Samuel E. Lunden, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274, (310) 833-1480

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Martha Munzer was thrilled to have been elected in March to the Women's Hall of Fame of Broward County, Fla., which includes her hometown

of Lauderdale-by-the-Sea. She also reports that her 11th book, *A Living Histo*ry of the Everglades, will be "out" momentarily. Bill Elmer sends a letter entitled, "I'm Still

Kicking!" Excerpts follow: "...Here are a few 'kicks' for you...I'm interested in religion (and soon may have the opportunity to find out what either heaven or hell is actually like.) I get a publication entitled the New American View, which involves itself deeply in the question of Christianity vs. Israelism. This seems superficial to me because it completely neglects our earlier religion, Odinism. You may argue that Odinism should be neglected; nobody ever hears of it except for one startling fact—our weekdays are named for Odinist gods. Tuesday for Tiwa, Wednesday from the Norse god Woden, or Odin, Thursday from the war-god Thor, and Friday from Freya, or Frigga.'

About his own background, Bill writes: "One of my direct ancestors was a Bishop of London and a close confidante of the great virgin queen Elizabeth. I have over 50 patents." He closes his letter, "I'm extremely fortunate to be in excellent health, although my legs are starting to get a bit wobbly. I spend the summertime in New Hampshire just south of the Old Man of the Mountain, and the wintertime only a block away from the center of the fine town of Andover, Mass. Most wonderful of all, I have a marvelous wife, Cathleen, who makes sure that all my needs are splendidly met."

Professor Harold Abelson, MacVicar Teaching Fellow in the Department of Electrical Engineering and Computer Science, has been appointed to the Class of 1922 Professorship. This honor, which also includes a \$15,000-per-year scholar allowance, recognizes distinguished leadership in teaching and service to the community. The appointment, which lasts five years, begins July 1, 1994.

Professor Abelson joined the MIT faculty in 1977, and has introduced numerous innovative teaching techniques. He is the author of six books on computer programming and his speciality is in the role computers play in learning.—ed.

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MA 02650

Please send news for this column to: Royal Sterling, secretary-treasurer, 2350 Indian Creek Blvd. W., Apt. 201D, Vero Beach, FL 32966

I have had no newsy letters or any other kind from classmates. After the 70th Reunion we will have all sorts of information to exchange with each other I

am sure. My friend, Monie, and I are looking forward to coming to Boston in June. I certainly hope to meet some of you at that time.—Co-secretaries: Katty Hereford, 237 Hacienda Carmel, Carmel, CA 93923; Colonel I. Henry Stern, 2840 S. Ocean #514, Palm Beach, FL 33480

75 70th Reunion

Please send news for this column to: F. Leroy "Doc"
Foster, secretary, 434 Old
Comers Rd., P.O. Box 331, North Chatham,

Going on 95

hen one is reaching the end of the line, what is it that one has learned in these many, many years? I have a very simple formula: keep doing what you have been doing all your life, but modify it as you go. Thus, instead of a daily swim of five laps in the pool, I've gradually cut down to four, three, two, and sometimes one. But I've never skipped a day, even in winter (in a heated pool). My tough old body can take and enjoy the cold water, rain or shine, no matter what the season. My daily hike has also been cut in size as time progresses, but the enjoyment has remained constant. So may it continue as long as possible.

Some key words have come to mean much to me through the many years:

• Love is the source of all happy living.

• Endure—in every life there is some measure of sadness or tragedy. Stay firm as a rock, knowing that this too

will pass. And it does, for life is change.

- *Marvel* at the wonderous universe of which you are a part.
- Learn—to keep learning is to keep growing.
- Laugh at the tragicomedy in which we find ourselves, the actors, in the very joy of being momentarily on the stage.

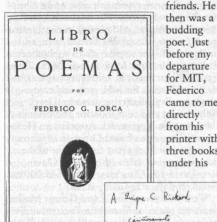
As for the inevitable approaching death, I turn to E. M. Forster's wise words: "It is thus, if there is any rule, that we ought to die neither as victim nor as fanatic, but as the seafarer can greet with an equal eye, the deep that he is entering and the shore that he must leave." The deep may actually turn out to be oblivion. One's hope is that one may live on for a while in the hearts of those whom one has loved. This is the only immortality I wish for. I hope that when it comes time to call it a day, I shall know that I have lived and that I have in some small measure shared my life with others. —MARTHA MUNZER, '22



For those of you who were fortunate enough to be nowhere near our alma mater you don't know what a horrendous winter you missed, the most snow ever recorded

in this area in known history.

We have heard from one classmate. Henry C. Rickard reports that all is OK at Fox Hill Village with himself and wife Frances, and suggests that the long incubation of his recent gift to MIT might interest others. He says: "from high school in 1920, I spent a year studying in Madrid at the Residencia, where a classmate, Federico Garcia Lorca, and I became good



poet. Just before my departure for MIT, Federico came to me directly from his printer with three books under his

arm—they were the first copies of his newly published work. One was for his parents, one for himself, and the third

was for me, warmly inscribed. For 73 years I kept this book among my favorite possessions....Federico attained early and broad success as a playwright, with characters and messages unfavorable to the then conservative government. So, in 1936 Franco's people murdered Federico. But his fame continued to expand, and remains great. Feeling that my Garcia Lorca book had become valuable, I gave it to MIT in 1993, after first having it appraised by a recognized specialist. He certified it as one of a very limited edition of the first published work of the Spanish author, whose works are most avidly sought by collectors-an outright rare volume. 'Conservatively' he assigned the value of \$10,000....I am pleased to have my book in the safe and appreciative hands of MIT. And I shall take the \$3,000 tax deduction this year. But I feel a bit uncomfortable benefiting from a gift that will provide no earnings to MIT. Therefore, I have given the \$3,000 to the Independent Residential Development Fund (and I will take the corresponding \$900 deduction in 1995).

And of course, we do have a couple of deaths to report: Machteld Elisabeth Sano, of Philadelphia, Pa., died November 28, 1993. ... John B. Jacob, of Columbia, Md., died January 22, 1994. He is survived by his wife, Harriet, and a son.

Please send news to: Donald S. Cunningham, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

Paul L. Sackett died on September 20, 1993, in Naples, Fla. Unfortunately we do not have his obituary to refer to. We recall he made a name for himself at MIT as

the best golfer in the class and a close match with our past class president Dwight Arnold.

E. Warren Ward died on November 29, 1993, in Lake Worth, Fla. He was president of Haley and Ward Inc., civil and environmental engineers, of Waltham, Mass., retiring in 1977 after 50 years of professional dedication to his firm. He retired from the U.S. Army as a lieutenant colonel, having served in the Pacific campaign during World War II.

In 1986, Warren was recognized at his 50th anniversary as past master of St. Bernards Lodge, AF and AM in Southbridge, Mass. He is survived by his wife, Edith, of 63 years having lived in Southbury and Framingham for most of their lives. They have a remarkable family of a son, two daughters, eleven grandchildren and twenty-one great-grandchildren.

John M. Pinkerton, Jr., died on January 13, 1994, in Holly Hill, Fla. A touching message was written by his wife, Evelyn, in response to a birthday card from the MIT Alumni/ae Association: "The family of John M. Pinkerton acknowledge your birthday wishes for what would have been his 90th. Pink was so proud of MIT as we all are. He had a very busy productive life. His company, Creole Petroleum Co., a subsidiary of Exxon, sent him to Harvard in 1953 for their Advanced Management Program. His motto was 'Do the best you can every day.' Guess where he got that! We lost a good man. Thanks for remembering him."

We send our deep sympathy to the widows and families of these three fine Florida class-

After almost 10 years of using an IBM PC Jr. computer, your secretary after three months of deliberation has purchased an upto-date computer with a 486, 2 megabytes of RAM and 130 MB hard drive and two disk drives and amazingly two controllable speeds. The new programs just won't run on an obsolete one that has served me very well. Possibly now you will be reading more sophisticated notes .- Joseph C. Burley, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; Lawrence B. Grew, assistant secretary, 21 Yowago Ave., Branford, CT 06405

First in our notes for this month shall be the joyful news of the marriage of our classmate Leon Locklin to Louise Rabun at the Cathedral of St. Philip, Atlanta, Ga., on

December 10, 1993. Leon and Louise had been long-time friends and co-workers at Georgia Power for forty years. Leon has changed his address from the Piedmont Extended Care Unit to 53 Rock Springs Rd., NE, Atlanta, GA 30324. Best wishes and congratulations to the happy couple.

In the interest of historical accuracy, Mary (Mrs. Arthur) Nichols has supplied details of the unique vehicles used by Art and his brother William (MIT '27) in commuting to classes, mentioned in the notes for the Feb/Mar Review. William had the conventional-drive Ford Roadster with a gas tank mounted high

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behind the driver while Art and his father had made the front-wheel-drive roadster using a 1924 Ford engine turned around backwards. Art and Mary's son Latham still has and uses this one-of-a-kind classic.

A message from Joseph "Monie" Monier covers his years in the chemical industry with Du Pont including those under the Atomic Energy Commission Manhattan Project. After four years of happy retirement followed by years of open heart surgery he has the fortitude to write a lengthy letter to the Review.

For the inevitable death notices, from which we have recently been relatively free, we have the following:

On November 14, 1993, Harold Fitch Lathrop, in Milan, Ill. Harold retired from refrigeration and air conditioning engineering with General Electric, Amana, and Bendix.

On November 24, 1993, Donald Endicott Perry, in Syracuse, N.Y. Don retired from air conditioning sales and engineering with Carri-

On February 3, 1994, Charles Austin Southwick, Ir., at Hilton Head Island, S.C. Charlie spent his working years in packaging engineering and consulting for the industry and his own company.

On February 28, 1994, Everard Mason Lester in Williamsburg, Va. Ev retired as VP of Foster-Wheeler Corp. after a career in aviation engineering with Pratt & Whitney Aircraft and Fairchild Aircraft and as an independent management consultant.

On behalf of their classmates I convey our condolences to their families.-Ernest H. Knight, secretary/president, Box 98, Raymond, ME 04071

This month we have three deaths reported by the MIT Alumni/ae Association. Olof P. Pierson, a native of Caribou, Maine, died November 3, 1993. He was known for

his invention of the frozen french fry, which he developed in the mid-1940s and were sold through the Birds Eye Co. He later became a United Nations consultant in the area of potato processing, machinery selection, and plant design.

Professor George F. Badger of Champaign, Ill., died on November 30, 1991. Also, a letter to George L. McKenna of Vero Beach, Fla., was returned "deceased," dated April 27, 1993. No further information was available about these men.

David H. Wilson of West Newton, Mass., died on September 19, 1993. Mr. Wilson was a civil engineer for the city of Boston for eight years before joining the Army, where he became a lieutenant colonel in the Ordnance Corps and administrative officer of the Watertown Arsenal. He was president and CEO of the Goddess Bra Co., which he founded in 1946. He was a member of the American Legion and the Jewish War Veterans; and a director of Temple Reyim in his hometown, and a member of the board of directors of United Cerebral Palsy of Greater Boston. He

leaves his wife, Ethel, three sons, eleven grandchildren, and five great-grandchildren.

Please send in news of your activities to: Technology Review, 1929 Class Notes, 201 Vassar St., MIT, Cambridge, MA 02139

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65th Reunion

This month we have a report from Fred Garvin from whom we have not heard in

about 15 years. Fred worked for many years for the Boston Department of Public Works. In later years, before his 1978 retirement, he was deputy commissioner and for a time acting commissioner of public works. He had a broad engineering responsibility in such areas as highways, water supply, sewers, and lighting. At the time he wrote he was recovering from a stroke and living in an apartment in the home of his daughter. Jean, at 44 Rustic Lane, Reading, Mass. His wife, Margaret, died in 1980. In addition to Jean, he has two sons and five grandchildren. Fred periodically touches base with Ed Giroux and would like to hear from other Course IV survivors.

William F.R. Griffith, Jr., worked for many years as a consulting engineer in Tucson, Ariz., in the fields of mechanical construction and air pollution control. Also, he was chief and developer of the Pima, Ariz., County Air Pollution Control Dept. Bill Jr. has a son William F.R. III, and a grandson William F.R. IV, who is a vice-president of American Cyanamide. Bill says he is "hale and hearty at 86. Just returned from climbing Chichén Itzá pyramids in Yucatan, Mexico."

Vince Thormin still lives in Calgary, Alberta, and stays remarkably active. He characterizes himself as a semi-retired pastor in which capacity he visits shut-ins for the Scarboro United Church. He also has become a tour guide. Thus in February 1993 he escorted a group on a cruise from L.A. through the Panama Canal. In July he ran an Arctic Circle trip that included Tuktovaktuk, the Dempster highway to Skagway, and a sail on the Princess to Glacier Bay and the Inside Passage. In October he was invited to attend the 135th anniversary of the first little church where he preached in the Eastern Township of Quebec. As a third 1993 activity he did 34 watercolor paintings that he sold or gave away. He sent me a sample of his 1993 Christmas card that he made using olive wood blocks that he had bought in Bethlehem, Israel. Vince must certainly be one of our most active survivors.

We have at hand notices concerning the deaths of two more of our classmates, both of whom made significant contributions to the MIT community. Ernest Fell, MD, died on December 18, 1993. While still an undergraduate Ernie did some landmark work. In 1926 a committee to determine the official MIT colors was appointed by the Alumni Council in order to establish on a firm scientific basis the criteria of color for the Institute. Samples of original material from the 1800s were analyzed at Eastman Kodak and by the MIT Color Laboratory. Ernie's research and thesis, entitled "Standardizing Cardinal and Grey Dyeings," was recognized nationally and his spectrophotometer readings are still the basis

for the MIT school colors. After graduating from MIT Ernie worked briefly for the American Printing Co. in Fall River, Mass., and then switched to medicine. He obtained an MD from Tufts in 1939 and thereafter practiced medicine in Fall River until his retirement in 1967. At one time he was city physician and in that capacity ran the city's Prenatal Clinic and Well Baby Clinic. He was on the staff of three different hospitals and chief of anesthesia at Fall River General Hospital. In addition to his medical activities, he was a director of the Fall River Savings Bank and the Public Library. Ernie's wife, Mabel, predeceased him. He is survived by a daughter and granddaughter.

Gregory Smith died January 25. After graduating from MIT in Course X-A, Greg went to work with Eastman Kodak Co. Soon thereafter he transferred to the Eastman Gelatine Co. in Peabody where in due course he became president, a position in which he served for many years. Greg had a great many outside interests. In his younger days he owned and sailed the Red Scare, a bluenose class sloop in which, with his son David, he won many races. At one time he was a trustee and board chairman of the J.B. Thomas Hospital in Peabody as well as trustee of the Salem Hospital. In later years he became interested in black and white photography and went so far as to study with Paul Caponigro and the late Ansel Adams.

Greg was an early advocate of historic preservation in his hometown of Marblehead. His support of this issue led to the creation of the town's Historic District Commission in the 1960s. His interest in historic preservation was fueled by his ownership and occupancy over many years of the Azor Orne House, an 18th century mansion built by one of the town's merchant princes in the Old Town district of Marblehead. From time to time Greg and Doris opened the house up to the public for charitable events. When he decided to sell the house and move to a seaside resort, he turned down more than 20 buyers who would not agree to language barring the subdivision of the property or its conversion into condominiums.

Greg also served his alma mater well. During his retirement years he spent long hours working on the development and operation of the UROP program. He also worked on promotion of the arts at MIT. He was the 74th president of the Alumni Association (1967-68), recipient of the Bronze Beaver Award, and an emeritus life member of the Corporation. He also served our class as president, reunion chairman, and class agent. He will be greatly missed. I may say that Greg's death is of more than passing interest to me; during our undergraduate years we often sat together in classes and sometimes discussed the possibility of going into business together after graduation, a project that unfortunately never materialized .- Gordon K. Lister, secretary, 5707 Williamsburg Landing Dr., Apt.40, Williamsburg, VA 23185

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Please send news for this column to:

Wyman P. Boynton, secretary 668 Middle St.

Portsmouth, NH 03801

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All plans are in place for an interesting reunion in Tucson for those who are able to attend. Sylvia and Russ Robinson have given considerable time to this event to

ensure a smooth, colorful get-together.

We have received two thank-you letters from the MIT students who have been selected to receive awards from the class of 1932 Scholarship Fund. The first, Michelle Neben, a sophomore from Lexington, Neb., has recently declared a major in biology and hopes to pursue a medical degree after graduation. Outside of her academic commitments, Michelle participates in novice women's crew and a Christian Bible study group. For relaxation, she enjoys art, singing, and playing musical instruments (piano, saxophone, French horn, and mellophone). The second, also a sophomore, Robert Stephenson, from Tellico Plains, Tenn., has chosen to major in aeronautics and astronautics. He rows for MIT crew and enjoys playing volleyball on the intramural level. Robert is an avid coin collector and belongs to the American Numismatic Association. He is active in a campus-based Christian organization and also works part-time in one of the dormitory snack bars. At our 25th Class Reunion in 1957, our class raised \$45,000 and established the scholarship fund.

We had expected Emily and George Muller to attend our mini-reunion in Tucson but we have received the sad news of his death. Russ Robinson, who knew George, wrote the following eulogy: "I'm sorry to advise that our gallant classmate, George W. Muller, died



Emily and George Muller, '32 Christmas 1993

peacefully this past New Year's Day after a very short illness. George spent his entire career in the sugar industry. He retired after spending 35 years with the National Sugar Refining Co., then retired a second time after seven years with Kerr McGee Chemical. Then for 10 years he was executive director of the international professional organization, Sugar Industry Technology. In 1946 he married his wonderful wife, Emily.

"I was sure that George would outlast us all! He was so remarkably fit and active. His favorite stomping grounds were the Himalayas, although he spent some earlier time exploring Central and South America. During World War II he served with the U.S. Army Air Corps which posted him to India and China. It was then when he made his first trek into the Kingdom of Sikkim, high in the Himalayas. He visited there, and Nepal and Tibet, several times over the years, sometimes with his wife and daughter, Sue.

"Even a few months before our 60th Reunion and at the age of 83, George was in Sikkim again, hiking to 13,000 ft. around the foot of Mt. Kanchenjunga searching for rare rhododendrons, of which he was a collector and well-known authority. We will sure miss George and Emily at our upcoming minireunion."

We expected Bernard McMorrow to attend our reunion. We were shocked to learn that, without being ill, he passed away on December 22, 1993. Bernard graduated in public health engineering. He initially worked as a sanitary engineering research assistant for Kellogg Corp. in Michigan, before moving to Phoenix, Ariz., to serve as county health officer. There he met and married the former Dorothy Madsen, a public health nurse.

In 1939, he moved to Hilo, Hawaii, to become sanitary engineer for the Big Island and was put in charge of rodent and plague control. In 1943, he became chief of the rodent control branch and moved to Oahu. He was made executive officer of the division of Sanitation and Environmental Health in 1944 and held that position until retiring in 1967. He is survived by his two sons, four grandchildren and one great-grandchild.

We have received word that Philip Coleman died in December 1992, in St. Augstine, Fla. He was retired president of Bristol Brass Co., and past president of the Connecticut Hospital Association. He had many civic, religious, and professional activities. He is survived by his wife, Elinor, two daughters, two sons, four grandchildren, and two great-grandchildren.—Melvin Castleman, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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"For the Wonder of It: the Arts at MIT" was the topic for Technology Day on Friday, June 3. A large part of the arts has been MIT's School of Architecture since its begin-

ning and now as the oldest school of architecture in the country. Those of us who have been there know it to be the finest as well. The feature of Tech Day was an interview of world-class architect I.M. Pei., '40, with the school's new dean, William J. Mitchell. The book I.M. Pei, A Profile in American Architecture accurately portrays him as the most durable architect working on a grand scale today. Dean Mitchell has an article in the February 1994 issue of Scientific American called "When Is Seeing Believing?" Tech Day will be reported on more extensively in the October issue.

Robert Heggie says the town of South Palm Beach has made him its first recipient as Citizen of the Year, 1993. Bob modestly admits to being vice mayor of the town from 1973 to 1976, president of the South Palm Beach Civic Association and chair of its Budget and Finance Committee, secretary of the Beach Nourishment Council, and serving on various

ad hoc committees.

Bob added that he liked my Christmas card so much that he adorned his bedroom mirror with it. (I am gratified that so many of you have responded similarly. My first Christmas cards were hand-pressed prints from linoleum blocks which we architectural students cut out at the firetrap Rogers Building so very long ago.)

Edward R. Atkinson writes that he was surprised anyone would even note or take time to research p. 15. The World of Charles Addams. He thought he could keep it as his private joke. (See TR February/March p. MIT 12.) Dr. Ed says he first noticed the cartoon in a 1938 New Yorker and never forgot it. He excuses himself by saying he sent out only 180 Christmas cards to friends and relatives (his first effort at this since his wife, Lorraine, passed away in July 1991). He had so many to answer back that he answered mine by saying my card was the largest and hence was at the bottom of the pile. But he added that he'll likely frame it. Keep up that great sense of humor, Ed. One day you're going to take a bow after a performance with your classmates-in 1994?

The most disconcerting news just received comes from the daughter of our beloved Ernesto de Sola. Nesto was one of the calmest and most debonair males of our architectural class. His daughter, Ines de S. Schedlbauer, says that after her father died of congestive heart disease on September 10, 1993, her mother, Alicia, passed away two months later on November 13. They were all vacationing in Miami when it happened. Both parents were born in San Salvador and their burial was there as well. (You will hear more about Ernesto when Ines favors us with biographical detail.)

Not wishing to leave with this saddening news, I want to call attention to an important MIT Alumnae project called the Margaret MacVicar Oral History Project and chaired by Bonny Kellermann, '72, associate registrar. It aims to document the history of MIT women with emphasis on their contributions at MIT and elsewhere so that today's women students can benefit from their predecessors' experiences. Most interviews will be with students currently in Cambridge. Of the eight women of our class, four are from Course IV. The Association of MIT Alumnae looks forward to a positive response to this call. Get in touch with Bonny at the Registrar's office, or phone (617) 253-9722.

Do keep me posted, please do!—Berj Tashjian, secretary, 1245 Briarwood Ln., Northbrook, IL 60062

There were plenty of responses from The Great Class of MIT 1934 60th Reunion Questionnaire which requested information for Class Notes: Lee Person sent his wishes for "Good Luck" at our 60th Reunion. He's been confined to a wheelchair for the past five years with one of his legs permanently stiff with a rod, but is able to walk with crutches and the help of an aide twice a day. . . . C. F. (Fred) Barrett is proud of his four children, nine grandchildren, and seven greatgrandchildren. The Barretts spend May to October in New York State and winters in

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Ocala, Fla.... Malcolm Stevens has a granddaughter, Chelsea, at Brown and is delighted to have her so close... Ernest Massa and wife Jeannette celebrated their 54th anniversary at the 60th Class Reunion at MIT in June.

Bill Ball writes to say he's still active as director and treasurer of the Dennis Taxpayers Association. . . . Gordon Burns reports he and his wife, Dot, are still in pretty good health and plan to attend the reunion "Happily, long retired," says Page Golsan, Jr. Page has two great-grandsons. . . . Melvin Sousa is still raising navel oranges, breeding and showing a few horses, and growing older. . . . "It's a great place, winter and summer," says Ernest Lockhart of "Olde Cape Cod." He attends a few MIT Club meetings and also does some winter traveling in the Bahamas. . . . William F. Buckley, Jr.'s, God and Man at Yale was published by none other than classmate, Henry Regency. Henry's coups as a publisher include, The Conservative Mind and The Failure of Technology. Henry's own Memoirs of a Dissident Publisher was published by Harcourt in 1979. . . . John Lazear lives in a retirement home in Minneapolis, near his son.

Eugene Magenau has the right spirit. He's building a one-room addition to his home and says it's fun, but often frustrating while coping with a painful rotator cuff, three fused disks in his spine, and the local building officials. . . . Mary Geittman advised us that she was going snorkeling with a classmate in February 1994. Let us know how you enjoyed it, Mary. . . Class President John Hrones stays in touch. He visited with Bissell Alderman in Joffrey, N.H., and expects to spend some time with Kingman Crosby, and wife Charlotte. . . Enjoying the pleasures of retirement, tennis, sailing, swimming, family, and friends, says Oscar Cantor. . . . Congratulations to Edward Asch and new bride, Annette, married this past summer. . . . Allan Q. Mowatt, '35, says he spent the first two and a half years in the Class of 1934 (until he got scarlet fever just before mid-year exams his junior year) so he has many friends in the class. . . . Whit Stueck, another member of the Class of 1935, wrote to say he, too, has many friends in our class and enjoys reading our Class Notes. . . . Walter Wise, Jr., writes that he retired as president of Milford Products and joined a Connecticut real estate brokerage firm selling industrial properties. . . . Jerry Winter is active as president of Components Corp., celebrating 50 years in business. . . . Retiree Edgar Chiswell travels quite a bit and is planning trips to Spain and Germany for 1994. . . . Donald Adler says his doctor restricts travel but sends "Best Wishes" to everyone for the 60th. . . . Yaw-Too Chin is retired, doing his best to stay fit, living with his third son.

"Still enjoying good health and spirits," writes Herbert Andrews. . . . W. Norris Parks and his wife live at 31 Stratford Rd., Newport News, VA 23601. He still does his own yard work and spends his spare time researching local maritime history and genealogy. . . A nice note came from Irving Kusinitz: "Marion and I have been living in the Sanctuary Con-

dominium since mid-1987. I have been involved in our condo management since the beginning, and a trustee for the past five years. We love it here with our many lawns and trees, and winding hilly lanes."... Walter McKay has heard from Wing Lem Wu.... Hal Bellinson is alive and well.

In Memoriam: Merrick E. Wheeler died October 25, 1989. He was inducted posthumously in the Telephone Association of New England Hall of Fame "for outstanding contributions to the Telephone Industry of New England" in September 1993. . . Richard Sanders' wife, lean, died on October 24, 1992.

... Bob Ebenbach informed us of the death of Winton Brown on October 18, 1993. Bob had kept in touch with Winton all the years since graduation. Winton is survived by his wife, Betty, two daughters, two sons, and twelve

grandchildren.

Raymond P. Holland's wife, Astrid, daughter of former track coach "Doc" Johnson, wrote that Ray died on November 29 in Roswell, N. Mex., after a long illness. At MIT, Ray was a Rhodes Scholarship candidate, was awarded the Stratton Prize, and was president of his fraternity, Lambda Chi Alpha. His achievements include serving as project engineer for the first STOL aircraft; design of Lockheed's P2V Neptune patrol aircraft. which holds the world's non-refueling flight distance record; and inventions including the moon landing trainer. He served as consultant to the Air Force Office of Scientific Research at Holloman Air Force Base through 1962. He was awarded two grants from the U.S. Department of Energy for the development of wind power generators.

Send your class notes to: Nancie Barber, acting secretary, MIT Alumni/ae Association, 10-140, MIT, Cambridge, MA 02139

60th Reunion

I am sorry to report the death of our popular classmate, Edward H. Taubman, on

January 22, 1994. He died of complications of emphysema and diabetes at Baltimore's Northwest Medical Center. After graduation from MIT, he returned to Baltimore to join his father's auto parts business. In 1942 he joined the Army (he was in the ROTC at MIT), and served in the Coast Artillery and Transportation Corps. He was discharged as a captain in 1945 and promptly joined his father again, with his brother Robert, in the family business. The three of them expanded the business by adding toys and developed 18 branch stores. In 1968 they sold the business and established Taubman Properties as a commercial real estate development company. Ed retired in 1985. In 1992, he and his wife, Cecile, celebrated their 50th wedding anniversary. Photography was one of Ed's hobbies, and he will be remembered by his classmates for taking camcorder pictures at our five-year reunions. He had quite a library of videos in stock. He is survived by his wife, a son, two daughters, three sisters, five grandchildren, and a great-granddaughter. I have sent our condolences to Cecile and her family.—Allan Q. Mowatt, secretary, 715 N. Broadway, #257, Escondido, CA 92050, (619) 432-6446

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Fred Assmann is our new class agent, replacing Henry Lippitt who had to resign last year after strokes and heart troubles. President Alice Kimball filled in during the interval. A

recent note from Ruth Lippitt included pictures of the 15th Reunion at Weekapaug Inn. In one, a jolly group of about 80 classmates and wives in long white aprons (for a clambake?) look up to the camera. Nearly every face can be identified, and the picture will be posted at the 60th.

Catching up on items accumulated in the last several months: from George Parkhurst to the Alumni/ae Association—"Extremely busy with genealogical research and writing articles on local history; working on a third book, and serving as president of the senior center in Chelmsford, Mass."... From Pete Weinert—"Enjoying retirement renovating an ancient log cabin, making a ship model, and volunteering in the local historical society."

... Year-end greetings to Pat Patterson from the Tony Hittls tell of more travel in Spain, Morocco, etc., and attending bridge seminars in Arizona and California.... The Charles Holman "both had a little minor surgery without any complications. At the World Skeet Championship last October, Lucy won a belt buckle for shooting 123 of 125 in the 12-gauge event." Charles won the Veteran Championship of Champions and was chosen captain of the All-America Team.

Gabriele and Allen Horton report his good health, except for mobility, yet he works out on a stationary bicycle and between parallel bars. Daughter Pam ran her first marathon, and daughter Caroline's two young boys like to cruise around the Hortons' 40 acres of vineyard in granddad's golf cart. . . . Margaret and Charles Price made a trip to Monaco with an Opera Pacific group. Charlie has overhauled his sailboat to be seaworthy again. . . . Mac Nyhen has been "into some chemotherapy—a bit of a drag."

From Traute and Ken Winsor a pen-and-ink sketch of a Santa Maria-type vessel arriving in Florida, entitled "Return of the Natives—we're here! barely, in every sense of the word." There is a good small foundry in town, and Ken expects to be sculpting again. Their Italian house remains unsold in a poor market. "It's difficult to accustom ourselves to the abundance and size of everything, including six and seven lanes of traffic in each direction."

For a while it seems that the class has been beating the odds on longevity. In 1993 only 20 names appeared in *Technology Review's* deceased lists, which is not many for a class of 295 active alums, all in their eighties or pushing. But about 90 have not appeared in these Notes since 1979, nor been heard from in any way other than maybe a 50th Reunion biography. Some may be dead. We will try to reach all survivors by telephone or mail this year and next, and hope to elicit some items for these Notes.

Now we pay tribute to the lives of five classmates—George Donnelly (Course XV), Winthrop Scott (II), Bernard Cosman (VI-A), Milner Wallace (VI-A), and Henry Lippitt, (XV). I was unable to visit George in Piqua, Ohio, on a trip last October, but his wife, Thelma, in a December note said: "If he were able, there is nothing in this world he would rather do than write about his experiences in

the newspaper business. He is hospitalized with lymphoma." A clipping from his hometown of Wellesley, Mass., tells of his death on January 9. George hired on at the New York City Daily News in 1936 and retired about 40 years later as VP and general manager. During WWII he was a major in the Air Service Command at Wright-Patterson. He was a director of the Chicago Tribune, WPIX-TV, and the Patterson Charitable Trust.

When visiting Elva and Win Scott in Seattle in January 1990, I learned he had suffered a debilitating illness, and they had moved to an attended apartment complex. He died February 21, 1993, but word came to the Institute only recently. His career with Curtiss-Wright and Boeing, and helping at the Seattle Air Museum were in the May 1990 Notes and 50th biographies. Now on the telephone, Elva spoke warmly of their 1940 marriage. A matchmaking woman friend in New York City, where Elva was a hospital dietician, invited each to dinner, and the introduction "took"

Bernie Cosman spent his entire career developing and manufacturing electronic equipment, principally for worldwide treatment of cancer and neurological disorders. With Professors Trump and Van de Graff, he built the



Bernard Cosman

first million-volt Xray generator for cancer treatment. In 1938 he and wife Lillian founded Radionics, Inc., and his son Eric, '63, a professor of physics, succeeded him as president in 1991. During WWII he was in submarine sonar research at Tech, with active testing in the South Pacific. One of his hobbies

was restoration of antique cars. Bernie's 50th biography mentions his "belief in a strong and close-knit family unit" and reflects his pride. He died December 29, 1993.

Milner Wallace's death on December 17, 1993, is a personal loss, because he, Bob Williams, (killed in a WWII air crash in 1944), and I were all Course VI-A and buddies on the Walker Memorial Staff. Also, Wally was a fellow oarsman and returned to the 50th and 55th Reunions to row with the class crew. Wife Ruth and daughter Robin took video shots from the launch. After 30 years with ITT Avionics Laboratory, Wally and Ruth did real estate sales in Saddle River, N.J., and there were items herein about his writings-for the local press on aspects of volunteer firefighting and a story for the MIT Crew Newsletter. They moved to Brookline, N.H., in 1988 and he was active in conservation and Nashua River testing.

The tribute (last issue) to Henry Lippitt's service as class agent was mailed to him January 29. He died March 9, and we have lost a faithful servant. The 1987 citation for his Bronze Beaver award includes: "a major force in class activities since graduation. His leadership in the Los Angeles area has done much to develop understanding of MIT and to achieve more effective alumni/ae relations." Henry graduated from Harvard Law in 1942, spent

three years in the Navy, and had a long career as an attorney specialist in natural gas legislation and regulation. His writings of industry newsletters, in Harvard and Texas Law Reviews, Public Utility Fortnightly, and several other publications; work on California gas legislation; and practicing law before state and national commissions and courts leave you wondering how he had any time left. But as President Alice said, he worked for our glorious Institute quietly, faithfully, and effectively. Cheers and glory to five productive lives!

Glorious indeed—read "MIT and the Overlap Suit: The Side of the Angels" by Susan Lewis beginning on page 1 of MITnews, Technology Review, April 1994.—Frank L. Phillips, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; James F. Patterson, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

Joan and Bob Rudy visit Cambridge, Mass., regularly.
They're very active in the arts and humanities program at MIT. During their trips, they are able to visit with their son and his family in Lexington and have get-togeth-

ers with the Peters, Youngs, and Thorsons.

Paul Allen, an independent mining consultant, sure gets around. He writes, "Our activities include travel, hiking, and cross-country skiing. In August-September 1993, we were on a Russian icebreaker as it attempted—unsuccessfully—to circumnavigate Greenland. In May 1994, I will be on a 10-day skiing and camping trip on the glaciers of the St. Elias Mountains in the Yukon Territory—my fourth such trip."

Harry Corman is semi-retired and selfemployed doing structural design. Enjoys tennis, golf, and playing the piano. He still maintains a house in Waterbury, Vermont, but finds it a little tougher to climb that ladder. He says, "My California daughter got her doctorate in psychological social work, my New York daughter writes for a business magazine." He was enjoying Naples, Fla., for a couple of months after "a vicious January at home." On a trip down to Florida he visited Sid Mank in Washington, Va. Sid is fighting lots of physical problems, but his spirits are good. Harry sends "all the guys the best" and adds this P.S., "I gave up the airplane and aviation in 1992-52 years is enough!" (Sid, we hope you've conquered all your health problems.)

Walter Lee (Pete) Hughes lost his dear wife, Eleanor, in 1988. He is retired from Tufts University as professor of physiology, but continues his interests: dabbling in biochemistry—selenium and ageing, and in the environment and population. Last summer, he and his sister, Ann, rafted down the Tatshenshini River from the Yukon to Dry Bay, Alaska, and found it a great wilderness experience. In 1991, he and Ann went on safari in Tanzania. Next year? (No couch potatoes, our classmates!)

Art Zimmerman retired as executive director of the Cleveland Commission on Higher Education in November 1990. He had been playing tennis three to four times a week until he had a spell as he and his wife, Agnes, were leaving for their daughter's home in Wisconsin for Christmas. In January, he spent two weeks in University Hospital for heart and blood pressure checkings. Hobby Hobson spent one

evening with Art, and Joe Keithley phoned while he was in the hospital. Art adds, "Now, two weeks later, I'm getting along on multiple medications. Prognosis is guarded as to any strenuous activity. Heart definitely weakened. Did attend one alumni luncheon in late January. My best to all in class of '37." Our best to you, Art, and hope this finds you in vastly improved health!

Good to hear from David McLellan who reports, "In January, Peggy and I celebrated our 40th wedding anniversary—everyone else, I guess, is way beyond us. I am now renewing my interest in kids and toys since my three sons have generally emulated their old man with late marriages, and, consequently, have young families. My activity has slowed down measurably, but any given day could include tree cutting or stone wall building. My diversion is to teach myself piano playing to defend myself from three musical sons. Physically, I have had the usual exposure of our age group to the medical problems of the day. My back is in good shape and my heart is still pumping. We stick close to New England-winters in Weston, Mass., and summers in Alton Bay, N.H. This regimen keeps me out of the heat which I dislike immensely."

Joe Sousa dropped a note saying he occasionally attends the New Haven, Conn., MIT club meetings and still goes to the Southern Connecticut State University a few nights each week to brush up on his computer programs. Joe explains, "If you don't use 'em, you forget 'em."

Your class secretaries, Thorson and Seder, thank those of you who have responded to our requests for news for this column. (Bet the first thing you do when you receive your copy of *Technology Review* is turn to the Class of '37 notes.) We urge you to keep us posted as to your interests, activities, hobbies, etc. Your news is of great interest to all our class members.

And now to the part of the class secretary's job that saddens me, to hear of and report the deaths of our classmates. Phil Dreissigacker died on February 19. He worked as an engineer for the Farrel Corp. of Ansonia, Conn., was a World War II Army veteran, member of the American Legion and the Milford Yacht Club, and a past member of the Orange Finance Committee and the Orange School Building Committee. Besides his wife, Ruth, he leaves two sons, a brother, a sister, and five grandchildren.

Bernard E. Ross died December 1993, in Port St. Lucie, Fla., where he had lived for 32 years. He graduated from MIT with a bachelor of science degree in biology and public health. He received a PhD in physiology in 1941 and a doctor of medicine degree in 1942, both from the University of Chicago. He was an assistant professor of physiology at the Miami Medical School from 1952-54; and, adjunct visiting professor of mathematics at the University of South Florida from 1982-1984. He was co-founder of the Port St. Lucie Hospital, now HCA Medical Center of Port St. Lucie and chairman of its medical division in 1983-84. Survivors include his wife, Irene, two sons, both doctors, three stepdaughters, two stepsons, seven grandchildren, and a great-grandchild.

Archibald R. Graustein, Jr., died at his home in Waterville, Minn., on September 30, 1993. Following are excerpts from his obituary in *The Free Press, Mankato*. He received a degree in electrical engineering from MIT. While at

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MIT he invented a new instrument for the recording of "brain waves," electro-encephalograms. His career started with Thomas E. Edison Laboratories in West Orange, N.J. Then: founding member, VP, and secretary of Cardion Instrument Corp. of Glen Ridge, N.J., a high-tech medical instrument research group; assistant to the president of The Gray Mfg. Co. of New York City and Hartford, Conn.; in charge of development of the alkaline cell battery for Ray-o-Vac Co. in Madison, Wisc.; with the E.F. Johnson Co. of Waseca, Minn., where he was a pioneer in the field of low-cost, CB radio for general public use, and led the company to a predominant position in that market. During World War II he served as a major in the U.S. Army Signal Corps. He is survived by his wife, Elaine, and four children, and four grandchildren. And a sad follow-up note from daughter Hilary Herbig Bevan: "It is with great sadness that I must tell you that my father died September 30, 1993, and that my mother, his wife of 52 years, followed close after him in death on January 6, 1994. Please be assured that he was a proud and dedicated MIT man to his last days!"

We extend our heartfelt sympathies to the Dreissigacker, Ross, Graustein, and Herbig families.—Robert H. Thorson, secretary, 66 Swan Rd., Winchester, MA 01890; Leonard Seder, assistant secretary, 1010 Waltham St., #342B, Lexington, MA 02173

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As we put these notes together, Don Severance is still receiving replies to our "market survey on the 1994 Mini-Reunion, June 3-4, during MIT Alumni/ae Week. By the

time you receive this issue of the *Review*, you will have learned what we are now trying to forecast! Our letters went to all classmates who had participated in our maxi-reunions (five-year intervals) and our mini-reunions (annual), seeking guidance on how best to coordinate with their current and projected schedules. Fortunately, we have all been schooled in the fundamental engineering skill: deriving optimum conclusions from incomplete data!

Many of the replies recount busy agendas, possibly extending months ahead. Like Bob Johnson, who reports, "We will be in Ireland!" And some who have done even further advance planning are reporting, "See you at our 60th in '98!"

Rafael Sanchez shared the tensions of the January 17 California earthquake, in a note to his Course VI lab partner, Don Severance. During breakfast in Miami the day of the quake, they heard the TV news, and Rafael immediately tried to call their son in Granada Hills. Of course the phones were jammed! Ten hours later their son was able to call them, reporting, "The furniture in the house was destroyed. The fireplace came down. The bookshelves dropped all the books. We were quite shook up, but suffered no physical injury." It was a similar quake in 1971 that convinced Rafael to move out of the area! But

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MARLBOROUGH OFFICE: 62 COTTING AVENUE MARLBOROUGH, MA 01752 Sewall P. Bronstein Donald Brown Robert L. Goldberg Robert F. O'Connell, SM '53 David G. Conlin George W. Neuner, SM '66 Gregory D. Williams Ernest V. Linek Linda M. Buckley

David S. Resnick Peter F. Corless Kevin J. Fournier

Henry D. Pahl, Jr.

Ronald I. Eisenstein

Of Counsel Peter J. Manus John L. Welch

his son, an animation specialist working for Universal Studios, is less flexible.

In this same eventful "occurrence," Russell Coile reports from Pacific Grove, Calif. "I had an interesting seven-day mutual aid assignment to the Emergency Operations Center in Los Angeles during the earthquake recovery period." Perhaps a natural assignment for a senior scientist at Evaluation Technology, Inc.?

Dale Morgan is also less flexible. Regarding the Mini-Reunion, Dale expects to be attending a grandchild's graduation about then!... Bruce Leslie reports that they are "well and comfortable" in Bristol, R.I., and in touch with some Course II-A pals. He comments on the pleasure of having their youngest son and his family nearby in Newport, where he is dean of students at St. George's (Prep) School. The oldest son is a full professor in higher education at Florida State in Tallahassee. Middle son Richard, '66, is in charge of L.L. Bean's business in Japan.

We have a letter of appreciation from Jeffrey Olson, '94, who writes: "I would like to

thank the Class of 1938 for renewing my Scholarship Fund Award. A significant part of my MIT grant was made possible by you." Jeffrey is now negotiating job placement to follow graduation. "When I become somewhat established in a profession, I really want to start giving to my Class Fund. You are doing a wonderful thing. I hope I may do the same for an MIT student in the future."

Fred Reuter describes his strategy for dealing with winter. "Cleveland is a mighty fine place to live, particularly if you love flowers, have a small greenhouse, and a degree in ikebana." Fred carefully directs the progression of blooms through specials for each holiday season and the culminating "summer bounty." "Culture abounds in Cleveland. To keep the little gray cells from atrophying, we took an appreciation course in contemporary art. We did another in medieval history given by the Jesuits at John Carroll University. The closest we got to heaven was Valhalla while listening to Wagner's Das Rheingold with von Dohnanyi conducting."

Paul Tillson, now in Augusta, Ga., reminds us of the truncated experience of a transfer student. In his two MIT undergraduate years the first involved many specially selected courses to complete his preparation, and the second was in the Course X Senior Honors Group. "You will remember we in the Honors Group were pretty well isolated from the rest of the senior chemical engineering students. The result was that I knew only those who went with me into the X-A graduate school"—a route that took him, eventually, to Gulf Oil's Patent Department.

John Sullivan was honored in November by the Dayton AIA with its Leadership in Architecture Award. (This clipping was forwarded to us by Roberta Homer, who is pulling their household back together!) As a former partner in the firm Yount, Sullivan & Lecklider, John was a principal designer of the Kettering Memorial Hospital and its school of nursing, Cox Memorial Heart Institute, Grandview Hospital, the NCR Credit Union, and three buildings at Wright State University. He also worked on many large houses.

"I lived in the golden age for architects," John said. During John's active years, the architect was "the chief" on major projects. "Today it's the developer, the money man, the people who build all this mall stuff—great big ugly-looking houses and overdone commercial structures. The architect today is just a necessary evil. They need him to draw plans after they decide what they're going to do."

Sullivan's civic work makes a longer list than his buildings. He was president of the Montgomery County Historical Society and president of the Dayton Art Institute board of directors. He was the first president of the Muse Machine, and was director of the Dayton Foundation. He also served as director of Grandview Hospital and as a member of the Cornell University Council.

Irwin Freydberg, in Chappaqua, N.Y., passed away on December 16, 1993, while undergoing an operation, his son reports. Upon graduation, Irwin joined the Air Force until 1946, when he went into the textile apparel manufacturing business. In 1968 he moved into real estate and founded Chappaqua Travel.

George Wood passed away last December 26 in San Diego, his daughter advised us.

George began his career at the ICE Lab at MIT, working on mechanical and electrical engine performance analysis before moving on to work in the field of accessory design and development at American Bosch. Then after working for a textile machinery company, he moved on to torpedo research and development supervision in Newport, R.I. From there it was natural for him to move west to San Diego to work on Atlas and Centaur instrumentation and performance analysis for General Dynamics/Convair before retiring.

Melvin Feins died suddenly on January 24 in Manchester, N.H., according to his wife, Ann. Melvin worked for 40 years at MKM Knitting Mills and Hampshire Designers in Manchester. He became division head of MKM Knitting Mills, Inc. Melvin was the founder of Identifications Unlimited and also was a founder of Derryfield School. He was a member of Temple Adath Yeshurun and the temple Brotherhood. The Feinses have two sons and a daughter—all three being doctors of medicine.

We also have notes about two classmates who are convalescing. Rolland French, retired in Shelton, Conn., had a stroke and is limiting his activities. He most recently worked for Phelps Dodge and the Copper Development Association. . . . Jack Wilber is in the Lutheran Home, Worcester, Mass., his wife advises. As staff engineer at Norton Co., manufacturing grinding wheels, Jack traveled extensively in Europe, South America, South Africa, India, and Japan.-Frederick J. Kolb, Jr., president and acting secretary, 211 Oakridge Dr., Rochester, NY 14617-2511, (716) 342-3093; Gretchen Birge, assistant secretary, 233 Carroll St., Apt. 202, Sunnyvale, CA 94086-6264, (408) 736-5011

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Seymour Sheinkopf, class president, and Sylvia report from their snow-covered front yard in Burtonsville, Md., that, after having compiled the family genealogy for 125

persons, they took a three-month sabbatical. Now, fully rested, they are ready to celebrate the 51st anniversary of their wedding.

Jim Barton and Mary sent a newsclipping that William King Cutten and his father, Leverett Howell Cutten, '07, funded a new professorship at MIT. The first holder is Dr. Merritt Roe Smith, professor of the history of technology and director of Program in Science, Technology and Society.

Leonard Mautner and Marguerite expect to attend 55th Reunion. Leonard's career included work at MIT Radiation Lab during World War II and at Hughes Aircraft afterward. He organized and sold several businesses, He lectured for many years at the UCLA Graduate School of Management and he organized the MIT/UCLA Venture Forum and served as its chairman 1982–88.

Bob Withington, former VP of the Boeing Aircraft Co., and Betsy are invited to participate during April in delivering to El-Al airline, Israel's very first 747-400. They expect to attend our 55th Reunion and other June week ceremonies at Boston University.

Ernie Kaswell and Yolande suggest classmates who embrace the faith might like to visit the Truro Synagogue which is located near to Newport, R.I., and which may have been the first or second one to be established in the Colonies.

David G. Kaufman, Course VII, consults with the federal and professional organizations responsible for evaluating new medicines. After MIT, Dave joined the Manhattan Project. Eventually he changed to hospital-associated work where exciting experiences started just after the very first heart transplant and continued for 20-plus years. Dave plans to drive from Connecticut to Spokane, Wash., to visit his daughter.

Paul Sandorff, retired in San Clemente, Calif., tells happy stories. His career included services with Lockheed Aircraft Co. and at MIT on its staff. Ideally situated near to the Pacific. Paul cultivates a tree which yields as many as 120 avocados (sized like softballs) per year. He donates some of the abundance to the senior center. He enjoys bridge, dabbles in and marvels at his computer, and says: "am not doing anything these days and I am enjoying it."

Hans Bebie attended a meeting in Seattle at which Chairman Paul Gray spoke. Hans was accompanied by his neighbor, Maurice E. Shank, '49. During July 1942 second lieutenant Maurice E. Shank and 26 other officers including myself became the charter cadre for a new Ordnance Heavy Maintenance Battalion assigned to work the next year and a half in the vicinity of Cairo, Egypt's sphinx, and pyramids. Our job was to repair tanks, artillery, and small arms damaged during the El Alamein turnback of the German and Italian armies. Fifty-one years later, I mentioned that to Jim Barton who instantly recited verses explaining why the sphinx wears her inscrutable smile. End of another vignette for the department of "It's a Small World."

Morrie Nicholson volunteered to continue the good works and funding initiated five years ago by Mike Herasimchuk and other '39ers who established a fund to show their appreciation to MIT for its contribution to their careers in mining and metallurgy. Classmates who desire to contribute now are invited to phone Morrie at (612) 645-1613.

Roy D. Haworth, one of the few who made dean's list eight times, sold his business to manufacture tungsten carbide tipped mixers and plows, and he retired in 1982 to Dayton, Fla. In spite of a hip replacement, he golfs regularly and hopes to see Dave Frankel and Clint Hilliker at the 55th.

Burk Kleinhofer, recipient of the George B. Morgan '20 Distinguished Service Award, reports from Long Beach: "I just returned from the Bob Hope (golf) Classic in Palm Desert and learned that Humbert P. Pacini ('Patch') went to the great beyond on February 7, 1994. We were lab partners and Course VI thesis partners and we stayed in touch all

through the years."

Ages of '39ers are in the high 70s. Receiving 74 obituary notices about classmates during the last five years prompts me to share some statistics. At MIT between 1862 and 1993, 128,933 persons graduated, 33,577 have died, and 95,356, including about 300 '39ers, are living. Death rate in our class for the last 15 months is about 1.2 per month. I have no statistics about deaths of spouses, but ladies tend to be longer-lived than men. I observe that George Cremer, Barry Graham, and Gus Hunicke suffered intense sorrow and grief after the extended terminal illnesses of their beloved wives. It seems to me that '39ers have

unique sympathetic resonances with one another, and naturally are providing the comfort, and encouragement necessary during extraordinary emotional stress.

We are saddened by news of the deaths of three classmates. From the Christiansburg, Va., News we learn that Roger Barrett Bross died November 21, 1993. He graduated with a degree in electrical engineering and he worked with Dr. Draper in the Instrumentation Lab. In 1964, he moved to Radford, N.C., and worked with Inland Motors until his retirement.

The Woburn, Mass., Daily Times Chronicle reported that R. Wade Caywood, a 44-year resident of Reading, died January 1, 1994. He also graduated with a degree in electronic engineering. He was president of the James Millen Manufacturing Co. in Malden for many years, then owned and operated the Caywood Electronic Co., retiring in 1987. He was past president of the Rotary Club International and was on the Board of Trustees for both the Malden Trust Company and the Malden Savings Bank. He was an avid ham radio operator.

From the Denver Post we learn Bascom C. "Em" Emerson, a retired executive, died January 4, 1994, at home. In 1949, he married Sue E. Brown in Mount Vernon, N.Y. Emerson was a vice-president of Gates Rubber Co. He served in the air force, and was a member of the Denver Lions Club. He was also past chairman of the Board of Goodwill Industries. He enjoyed golf and skiing.—Hal Seykota, secretary, 2853 Clairmont Dr., Tacoma, WA 98407

55th Reunion

By now, you have all received the letter from Class President Norman Klivans with many of

the details concerning our 55th reunion a year from this June. Included with the letter was a list of those classmates who are considering going to Woodstock, Cambridge, or both. You also received information on various ways of making donations to alumni/ae funds or the class treasury. Feel free to take advantage of the opportunity.

There have been more responses to the reunion questionnaire. John Parnell says that he is engaged in township government, is an amateur radio volunteer examiner, and occasionally serves as a Meals on Wheels volunteer. . . . Herbert Weiss writes, "Retired, living in Lexington, Mass. Keeping very busy with grandchildren, my computer, and travelscruising on my sailboat about 60 percent of the time, last winter in Central America. Plan to visit my son in Africa soon. He is in Kenya doing malaria research."

And from Samuel "Spec" Card: "After working two years for 50 hours a week to put together the City of Cape Coral Children's Science Center, of which I am a co-founder, it opened a year ago to the public as a hands-on museum. We have logged 33,194 visitors in just 12 months! Am having a ball serving as executive director of the museum and as president of the parent corporation, the Math, Science, and Technology Foundation of Florida, Inc."

In spite of various physical problems that his wife of 52 years has had, Wally Schuchard and

ClassNotes

Peg travel all around the country. Much of the travel is tied to his business as a consultant, to attend National Fire Prevention Association meetings. As NFPA meets in interesting places, Wally frequently extends the trips to take in some of the local attractions. In addition, he has utilized his travels to visit with classmates, such as Elsie and Bill Schnorr in El Cajon, Calif., and Cal and Pete Singleton. Pete, Wally reports, is now retired from the corporate world and is a cattle rancher in California.

I must report four deaths at this time. William C. McDonald of San Diego, Calif., died on January 4, 1994. He had retired in 1988 from active work as VP of the Kaypro Corp., a computer maker. In Wilton, Conn., John H. Bech died on February 18, 1994. He had been president of Tech Advertising, Inc., a Stamford, Conn., advertising and marketing firm. He had previously worked for McCann Erickson, Bendix Aviation Corp., and Johnson, Nevell. He was active in many areas of town affairs, serving on various councils, the Chamber of Commerce, United Fund, Boy Scouts of America, and business associations.

Edith M. (Mrs. Philip E.) Hoyt passed away on December 5, 1993, in Skowhegan, Maine. At one time, she was employed by General Electric Co. River Works plant in Lynn, Mass., and then became a math teacher in Skowhegan from 1962 until her retirement in 1981.

On February 15, 1994, John J. Casey died at his home in Port Washington, N.Y. John served as a test pilot during World War II, and commanded the transport squadron for the Manhattan Project that worked on the development of the atomic bomb. He was assistant VP at American Airlines before joining Braniff in 1968. He became chairman and CEO there, and later held a similar position at Pan Am's commercial services unit. After retiring in 1988, John formed his own aviation management consulting firm, and remained active there until his death. He also served as an executive and volunteer with the Boy Scouts of America for 38 years.

On behalf of the Class of 1940, I extend sympathy to all the families who have lost a dear one.

Recently I had lunch with Walter Kahn and Bob Sackheim, '39, in Mamaroneck, N.Y. Walt is busy with his hobby cum business of doing fine art and china repair. He has



Robert Davis

become a student of the War of 1812, and regaled us with tales of that era. He is also involved in building models of sailing ships, including the U.S.S. Constitution-Old Ironsides.

A news release from the National **Executive Service** Corps reports that Robert J. Davis was recently honored by NESC in their New

York offices for his volunteer consulting services to the Jewish Home and Hospital for the Aged. He had investigated ways in which JHHA might expand its research activities. Previously, he held executive positions with FMC Corp. and the international division of Hooker Chemical, and served as president of World Trade at Champion International. Bob describes his working conditions now as "twice the work, half the pay, and double the pleasure!"

Keep those letters and messages coming to Richard E. Gladstone, secretary, 250 Hammond Pond Pkwy., Chestnut Hill, MA 02167, (617) 969-5161

MIT forwarded brief notices of the deaths of two classmates. J. Cranston Gray, of Greenville, S.C., on April 8, 1993, and A. Hoadley Mitchell of Edmunton, Alberta, Canada, on January 9,

1994. There were no other details. The class expresses its sympathy to their families.

The February/March issue notes briefly

The February/March issue notes briefly mentioned Quentin Wald's nautical adventures. His promised expanded account is included here. He writes: "Soon after retirement in 1985, I went to Europe to find a suitable sailing yacht for a Mediterranean cruise. In Mallorca, I bought a Swan 37, which I named Anaximander after the Greek philosopher. The following summer, with my daughter and a young Canadian, I sailed the Aegean, spending the balance of that year, and the two succeeding seasons, cruising among the Greek islands, and later on the coast of Turkey.

'At the end of the first summer, I found myself without a crew, and not finding a suitable place to winter the boat in Lesbos, I decided to take Anaximander back to the Greek mainland. I left one morning and the following night was one of the most memorable sails of my life. There was a full moon, but joke on me, there was a lunar eclipse which engulfed me in several hours of total darkness. I napped 15 or 20 minutes at a time while the boat sped through the night, taking good care of herself (and me). In the early morning hours, I sat warm and dry behind the dodger, enjoying the spectacular silvery night and glittering spray under the restored moon. I had a glass of ouzo and listened to music from Athens.

"I spent much of the succeeding winter living in a village in the hills of Lesbos, the only foreigner in the village. The Greek Islands have a haunting charm and the people are delightful. However, the Meltemi, the north wind that blows in July and August, is at times, quite literally hair-raising!

"After cruising part of the beautiful coast of Turkey, I decided to return to Spain. The Englishman who was crewing for me left me in Sicily so I sailed the 500 miles or so to Mallorca alone, without stops, in five days at sea. I had always wanted to prove to myself that I could enjoy a voyage of some length alone. With the aid of the windvane steering, modern furling gear, not to mention luck with the weather, I was able to satisfy my desire.

"I cruised the south coast of Spain and decided to cross the Atlantic to the Caribbean late in 1988. Paul Dwyer, a young Australian, came aboard as crew in Gibraltar. We sailed from Gibraltar for Madeira in October 1988. Three days out, on Paul's watch, I was awak-

ened by a tremendous roar. I rushed on deck in the dark and beheld an enormous whale, whose exposed back was nearly as long as the yacht. He cruised alongside for nearly half an hour before he left. I was surprised by his very evident interest in us. We arrived in the Madeira archipelago after eight days at sea. We enjoyed Madeira, the greenest of Atlantic Islands, and then continued to Las Palmas, Gran Canaria.

"My older son, Ansel, joined us there, and with the Atlantic Rally for Cruisers, we sailed for Barbados. There were about 150 boats enrolled in the ARC, which is organized as a trans-Atlantic race. Two days after the chaotic start, we were alone on the vast ocean and saw none of our competitors until we

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cruised alongside for
nearly half an hour
before he left."

-Quentin Wald, '41

approached Barbados, 23 days and 2,700 miles later.

"...Passing over several adventures, I eventually found myself near Charleston, S.C., just in time to meet Hurricane Hugo in September 1989. Poor Anaximander, with most of the other boats and floating docks in the marina, was carried half a mile, ending up in a heap. Fortunately the hull was not punctured and I was able, at considerable expense, to get her off and refloated. We limped up to a friendly boatyard near Wilmington, N.C., where I spent more than a year restoring the boat to sailing condition.

"After spending some time in Florida, I sold the boat with very mixed feelings. It was great while it lasted, but at my age, and without a regular crew, it was time to retire to the shore. I purchased a small house in Port Townsend, Wash., where I am near two sons and have a daughter in California. I will be busy with a garden, some shop projects, and two writing projects, but will miss the sailing life in the Mediterranean."

Our class is fortunate to have this preview

of what may well be one of Quentin's projects, a best-seller travel adventure!—Charles H. King, Jr., secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

Thanks to Floyd Lyon for his years of service as class agent. Our new class agent is Lou Stouse. You can send money and/or pledges to him at 2420 Buena Vista Rd., Winston-

Salem, NC 27104. For really fast service, his phone number is (919) 723-9823.

Spent a pleasant evening in February at the home of Hazel and Fred Fander in Dunedin, Fla., with Charlotte and Ed Edmunds visiting from El Paso and Audrey and Jack Altekruse from close-by Largo, Fla. Ed operates plants in Juarez, Mexico, building and maintaining molds for plastic production and doing some molding of his own. He also operates a microwave tower and sells microwave and radio equipment. While here, Ed playing with Fred cleaned up the local tennis opposition in straight sets, 6–1 and 6–1.

Got news from Ed that Bob Given has retired. Best of luck to him in his new status. . . . Dick Haven, in a letter to the Alumni/ae Association, brought our list of obits up to date with some not yet reported here. They are Lisa (Minevitch) Finney, Bill Hendrich, Milton Kaplow, Ken MacIlroy, John Phelps, and Harold Ring. Our condolences to all of their families.—Ken Rosett, secretary, 281 Martling Ave., Tarrytown, NY 10591

I have recently received an Alumni/ae Association obituary notive dated May 19, 1993 (!) reporting the death on April 12, 1993, of John E. Guillotte (Course XVIII),

Wilmington, Del. A native of Massachusetts, John had a 42-year career with Du Pont, including work in the Manhattan Project on technical problems in the manufacture of plutonium for the first two atomic bombs. He was a founder of the Delaware Senior Babe Ruth Baseball League and served on the Stanton Board of Education. Our sympathies go out to his wife, Lois, and the other members of his family.

Samuel R. Maloof (Course III) sends word from Belmont, Mass., where he is an environmental management consultant, that he is currently working on "an innovative and environmentally superior ocean dispersal sludge management plan for Boston." . . . Dick Zeamer is one of two (so far) requesting a list of 50th Reunion attendees. Dick is a semi-retired consultant in Salt Lake City.

Send news!—Bob Rorschach, secretary, 2544 S. Norfolk, Tulsa, OK 74114

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By now we hope all of you who attended our grand 50th Reunion at the Samoset in Maine and at MIT are relaxing in the afterglow. It is our intention to have a mini-

reunion in about two years at a more relaxed pace, probably in the spring or fall depending on location.

Arturo M. Morales Dominguez sends word

from Mexico that he is still active in the Mexican Academy of Engineering and also as a board member of three companies.

Again we regret to report the passing of two of our beloved classmates: Pierre Boucheron, Jr., passed away February 27, 1994, in Barboursville, Va., after a long battle with cancer. He leaves his wife of 50 years, Charlotte, a daughter, three sons, and four grandchildren. Pierre served as a signal corps officer during World War II; he installed and operated vital radio communication networks throughout Europe. He also served during the Korean War as engineering officer for the U.S. Army's first mobile television unit. After World War II, Pierre became a development engineer for NBC in New York City where he designed some of

the early television broadcasting cameras and recording equipment. Following the Korean War, he joined GE in Syracuse, N.Y., and designed computers for use with military radar and sonar systems. Subsequently he became a consulting engineer on the corporate staff of GE in Schenectady. In 1981 after 29 years with GE, he retired in Charlottesville, Va. After retirement, his interest turned to the study of precision pendulum clocks where he achieved international renown for many articles on the science of horology.

Mrs. Freites reports the passing of her hus-

band, Andres A. Freites, on March 14, 1991, at Santa Domingo in the Dominican Republic. No other details at this time. The Class extends its deep sympathy to the families of Pierre and Andres.—Co-secretaries: Andrew F. Corry, P.O. Box 310, West Hyannisport, MA 02672; Louis R. Demarkles, 77 Circuit Ave., Hyannis, MA 02601

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50th Reunion

A year from now we shall be basking in the memories of our fabulous 50th Reunion

celebration in Cambridge and Prout's Neck, Maine. If you have not already done so, please send your \$50 class dues to Jim Pickel at 110 Cleveland Ave., Braintree, MA 02184-4904. Also send your biographical data including a current photo to Bob Maglathlin at 601 Grove St., Norwell, MA 02061-1207. If we haven't heard from you, you shall be hearing from us!

Walt Borden reports that he and Margo spent five weeks driving through Germany, northern Italy, and Austria last spring—also three weeks in Madagascar last fall, seeing most of the endemic bird species and over 50 percent of the lemur species.

We are saddened to report the deaths of Lester J. Biegler, Jr., of Mountainside, N.J., on October 23, 1983, and Walter "Okie" O'Connell of Palm Harbor, Fla., on December 25, 1991. We last saw Walter and Louise O'Connell at our 45th Reunion in Mashpee in June 1990.

Five former MIT Navy V-12ers attended the U.S. Navy Memorial Foundation's 50th V-12 Reunion at Norfolk, Va., September 28–October 1, 1993. In attendance were '45ers Ray Tully Bradford, Steve Eppner, and Mike Huston, plus Bob Nelson, '46, and Ed Egan, '49. The following synopsis is based on a six-page summary prepared by Bob Nelson.

To refresh your memories: V-12 was the Navy's largest World War II officer training program. It was a partnership between the U.S. Navy and 131 American colleges and universities that produced 60,000 Navy and



V-12 reunion goers were treated to a tour of the aircraft carrier USS
Theodore Roosevelt—a ship so large that "you could put about three of
the World War II carriers in it," according to Mike Huston, '45.

Marine Corps officers and a large number of national leaders. There were about 70,000 V-12s on active duty as of July 1943. By June 1946, a total of 125,000 young men had enrolled in the program. MIT, with 900 trainees, had one of the larger units. Many colleges had from 200 to 300. The smallest, Webb Institute of Naval Architecture on Long Island, had about 65.

The recent 50th anniversary celebration in Norfolk drew about 800 former trainees, wives, and friends. Activities included the usual speeches and the more interesting hands-on demonstrations, displays, and shipboard experiences at Little Creek, as well as both NAS and NOB, Norfolk.

Bob Nelson met up with Steve Eppner and his wife, Evelyn. Steve, who was in Company 8, graduated in October 1945 and went directly to a year of active duty as an ensign.

Rear Admiral Jim Miller, USN (Ret.), current president of the U.S. Navy Memorial Foundation, talked a bit about the memorial in Washington, D.C., and mentioned that Mobil Corp. sponsored the IMAX film now being shown at the Burke Auditorium at the Navy Memorial.

Now that we have whetted a few appetites, please be advised (sounds like Navy jargon) that the entire summary will be included in our 50th Reunion book. Have a pleasant summer.—Clinton H. Springer, secretary, P.O. Box 288, New Castle, NH 03854

ClassNotes

There's precious little news for this issue so we'll just get along as best we can. The first comes from activities sent by Dr. John L. Bateman who was a mechanical engineer from New York

who returned to Huntington, N.Y., and became associate chief of nuclear medicine service with the Veterans Administration Medical Center in Northport, N.Y.... Another item came through from Seward Kennedy who has been written

about previously. He has been in London, England, for several years doing consulting work plus collecting art and antiques. Seward has traveled a lot mostly in Europe. He still has an apartment on Park Avenue in New York and a penthouse apartment in the old town of Ibiga in Spain, all of which keeps him very busy. He's looking forward to the 50th.

We have lost another MIT friend, J. Graham McQuarrie, a chemical engineer who passed by on January 6. He lived in Camano Island, Washington.

One last item came through from Robert Hoffman who is drumming up for the "BIG

50th." WE'RE COUNTING UP FOR THE "THE BIG ONE."—Jim Ray, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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We talked to Ken Marshall recently; he and Lois were headed for Hong Kong and other points in the Far East the next day. He says they are spending much of their time "traveling"

aggressively." (Ann and I have the same attitude—it's lots of fun!) Recently Ken has been working on U.S. Olympic Festival 94, which will be held in St. Louis July 1–10. This event is held under the auspices of the U.S. Olympic Committee in non-Olympic years; some 3,000 athletes will be participating in 37 sports. The athletes range from Olympic medalists to first time amateurs. Depending upon performance, some of them will be part of the U.S. team in the Summer Olympics in Atlanta in 1996. Incidentally, Ken tells me the 1995 Festival will be in Denver, so maybe we'll get a chance to see it next year.

One obituary this month: Rae LaPier died in December 1993. He was living in Point Pleasant, N.J., and is survived by his wife, Carole. We don't have any more information.

That's all we have this month—the drought continues! Send us some news so we have something to put in our column!—R.E. "Bob" McBride, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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Sara (Bailey) Michal sent a note outlining her activities since graduation. From graduation to 1951, she was a chemist at Watertown Arsenal on an Atomic Energy Com-

mission project with MIT. The next 15 years were devoted to her family of four children while they lived in New Jersey. From 1966 to 1970, she taught high school chemistry. In 1972 her family moved to Golden, Colo., and she began her career in art. Now, Sara is a professional still-life artist. . . . Bill Weisz became chairman of the Board of Motorola last December. I will contact him and ask for more details to report in next month's column. .. Frank Heilenday is a consultant at RAND Corp. He has written a textbook, Principles of Air Defense and Air Vehicle Penetration, available through George Washington Univ. in Washington, D.C. Frank is consulting on a project at RAND to develop a computer simulation of air combat at the theatre level. The simulation is based on his book.

Julian Taub retired from Bloomingdale's. He joined Bloomingdale's in 1977 as VP, CFO, and a member of the executive committee. Since 1988 he had been senior VP of planning. Julian was responsible for analyzing businesses for profitability and ROI and preparing profitability analysis for capital expenditures on remodels, renovations, and new stores. Julian is starting his own consulting firm specializing in retail business. His first clients have an upscale decorative hardware store, and he expects to work on projects for a jewelry company and an espresso bar.—Marty Billett, secretary, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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As you read these notes, our grand and glorious 45th Reunion is now but a memory. However, because of the three-month lead time required to get this magazine

to the newsstands, a report on the event will not appear until the October issue.

Jack Baker has completed his twenty-third year as VP of Management Recruiters in Ann Arbor, Mich. He says: "Recruiting and selling used engineers and scientists is absolutely fun for a mature MIT alumnus. For 20 percent of my 500 hires, I put a rocket under their careers. Smaller firms and older engineers are a great match." Herb Federhen tells me his available hours are devoted to a handbell choir, his church choir, and a barbershop quartet. . . . Ray Larson is the treasurer of the Evangelical Covenant Church in Attleboro, Mass., where the membership totals 275.

When I last talked with Ken Prytherch, he was off to Ethiopia. Why I didn't ask him what he would be doing in that far-off country, I'll never know. It must be that my mind is going—or already gone. Ken is in marketing and purchasing at G.A.F.... Among three outstandingly successful children, Dick Lang's son, Jeff, '75, is a tenured professor at MIT. Dick is into astronomy these days and is building a telescope complete with a reflector he ground and polished himself. I recently read of an object in space some million light years distant. I must ask Dick: How can anything be that far away?

Jan Peyrot is officially retired, but Pratt &

Whitney needs his help so often that he works for them from one to four days a week. Ian attended our 45th Reunion after choosing not to attend the 50th Reunion of those who survived the assault on Omaha Beach. . . . I had always thought that Camp Hill, Pa., was the home of the Book-of-the-Month Club and little else. But no! It is the home of Harold McInnes, just across the Susquehanna River from Harrisburg. And over in Harrisburg, Harold is chair of the executive committee of Amp, Inc.; a member of the board of the Harrisburg Area YMCA: and chair of the board of the Harrisburg Hospital. Aside from these demanding responsibilities, Harold is interested in promoting education reform.

A recent letter to Tom Toohy, class president, from John Harbison, distinguished composer and holder of the Class of 1949 Professorship, brings us up-to-date on his mind-boggling list of accomplishments and activities. I have not the wisdom or the presumptuousness to omit anything from Professor Harbison's three-page, hand-written let-

ter—so I won't.

"Dear Mr. Toohy, It is a pleasure to be able to update you and your colleagues in the Class of 1949 on my recent activities. My teaching has focused on two areas: chamber music and composition. Those of you who attend Tech Day, June 3, may have a chance to sample some of the conservatory-level work going on in these classes.

"A number of my pieces have received their first performances in the last two years. Due Libre with the New York Philomusica and mezzo soprano Lorraine Hunt; Oboe Concerto with oboist William Bennett, Conductor Herbert Blomstedt and the San Francisco Symphony (the piece was also played on their American and European tours); Three City Blocks with the Air Force band conducted by Lt. Col. Stan Bonner; The Rewaking with Benita Valente, soprano, and the Juilliard Quartet; and The Most Often Used Chords with the Los Angeles Chamber Orchestra, Christof Pennick conducting.

"As you may notice, none of these first performances has been in Boston, so it is especially gratifying to look forward to three occasions in April: On April 6, the Boston Symphony, with cellist Yo Yo Ma and conductor Seiji Ozawa, will introduce my Cello Concerto. On April 17, the Emmanuel Choir will give the premiere of a large motet for sixvoice chorus Concerning Those Which Are Asleep (Craig Smith will conduct). On April 30, the Lydian Quartet will give the first performance of String Quartet No. 3.

"I have also been active as a conductor. While composer in residence at Tanglewood in the summer of 1992, I led two concerts with the Tanglewood Orchestra, one of which included the Schoenberg Violin Concerto with Rose Mary Harbison [Professor Harbison's wife] as soloist. I also led Boston's Handel and Haydn Society in eight performances of Handel's Messiah the past winter.

"I continue to serve as a trustee of the Copland Foundation, the Koussevitzky Foundation, and the American Academy in Rome. Together with service to the Awards Panel of the American Institute of Arts and Letters, I participate in giving out a couple of million dollars a year to various new music recipients, an activity I will soon need to curtail!

"I enjoy MIT students more each year. I

also benefit greatly from the various advantages available to the holder of a chaired professorship at our Institute. I hope I will have an opportunity to meet many of you June 2 and 3. Very Sincerely, John Harbison."—
Fletcher Eaton, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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45th Reunion

Having fled the Massachusetts winter for Vero Beach, Fla., I called some local classmates.

... Ron Brandon, after some years with GE, provides steam turbine technical services via Brandon Engineering in Melbourne, Fla... Richard Frank of Kissimmee, Fla., celebrated his 50th anniversary and had a quadruple bypass (not simultaneously). He is semiretired, consulting in electronics and digital control systems... Jim Hooper's son left the Army a year ago, joining his sister and Jim in the Cocoa, Fla., area where Jim enjoys them and five grandchildren. Jim continues to run the family real estate affairs after leaving the automobile business 15 years ago.

Leonard King retired from Allied Signal in 1987, where he was principal engineer. He lives in Boca Raton, Fla., and enjoys his five grandchildren, tennis, and (he claims) success in the stock market. Nice going, Leonard. . . . Joe Oppenheim of Satellite Beach, Fla., has written a sci-fi novel, Mind Wanderer. While he seeks a publisher he audits courses at the Florida Institute of Technology. . . . Speaking of FIT, Ken Sawyer, after retiring from the Army, in 1970 moved to Melbourne, Fla., and studied operations research at FIT. He then taught there until 1980. Ken likes Hawaii and recently had 12 delightful days in Rome. . . . Claude Tapley retired from Anaconda in 1976. He now consults in special metals and is providing the copper parts for Princeton's new fusion generator. . . . Jim Staikos, you ought to organize a mini-reunion there on the Treasure Coast.

Outside of Florida, Bob Roig has returned from Frankfurt to Reston, Va., where he continues with Mitre Corp. . . . Jim Goff is relishing his editorship of the journal of the Scottish Gaelic Society. (If I could read your writing, Jim, I would have used the journal's title.) Jim would like to hear from other MIT Scots.

If you have not done so yet, please send me your suggestions for our 45th Reunion in June 1995.—Robert Snedeker, acting secretary, 7 Mashie Way, No. Reading, MA 01864; John McKenna, secretary, 182 Midpine Rd., Cummaquid, MA 02637

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Retirement in the spring of 1992 has not slowed Roger G. Christmen for even a beat. He has been active in teaching, technical consulting, travel, sailing, and bridge. His five children

have all graduated from college (two from MIT) and have provided him with six grand-children to date.

Sadly, we have received word that Guy E. Inshaw of Los Gatos, Calif., has passed away. We extend our sincerest condolences to his family.—Martin N. Greenfield, secretary, 25 Darrell Dr., Randolph, MA 02368



Concerto for Yo Yo

lass of 1949 Professor John Harbison has received a breathtaking number of honors acknowledging his musical accomplishments: the Pulitzer Prize for Music in 1987 for his cantata, The Flight into Egypt; a MacArthur Prize Fellowship in 1989; and now from MIT, the Killian Award Lecturer for 1994–1995. (Given by the MIT faculty for outstanding professional achievement, the Killian Award citation recognized Harbison as "a brilliant teacher in the classroom" and "one of the leading compositional voices of our time.")

In 1993, Harbison was on leave from MIT composing commissioned works and this spring has seen a flurry of performances of the new pieces.

One of the most intimate and delightful occasions was at MIT: among the new works was a concerto composed for internationally acclaimed cellist Yo Yo Ma (commissioned in part by Lee Martin, '42, and

his wife, Geraldine). Before the April premiere performance at Symphony Hall in Boston, Yo Yo Ma came to MIT and rehearsed the piece in Killian Hall before an audience of 150 music students. Harbison had asked three MIT students each to prepare the piano accompaniment for one of the concerto's three movements for this rehearsal. Graduate students Elaine Chew (in white) and Jee Hoon Yap (in back) are shown in the photo above. Adrian Childs, a senior, also participated.

The best part of the experience for Elaine Chew was watching Harbison revise the concerto. "It was an unusual experience for me, watching the piece evolve. . . . It was also eye-opening to see a usually mild-mannered composer gleefully say, 'Yes, I can add notes when I want to, and I can take away notes when I want to!"

In an interview with Mary Haller, director of arts communication in the Office of the Arts, Harbison talked about the rewards of working with MIT students and how he coaches students in the chamber music program. "I try to make students care about the pieces as much as I do. . . I try to get them to hear and think about everything from small, technical issues to large-scale structure. But essentially, I let them take over as much as I can, because that's when they really play well."

In the interview, Harbison also noted his concern for the future of music audiences, observing that children don't have many opportunities to experience concert performances. To reach young people, Harbison recently wrote a series of pieces for the Music School at Rivers, in Weston, Mass.

(See John Harbison's letter in the 1949 Class Notes in this issue for a further description of his activities.)

Cliff Herdman took advantage of his new-found leisure to write that he had just retired at the end of January, and that he and his wife, Doris, intended to move to Cape Coral, Fla., within a month. Cliff had a 41-year career with the Port Authority of New

York and New Jersey, primarily planning

improvements in the three New York-area airports. He says that he enjoyed his work and that he will miss it, but he wants to enter retirement while he is still active enough to enjoy it. When he wrote, he was looking forward to some much-needed relaxation and permanent escape from the cold in Florida. The latter prospect doubtless seemed much more attractive in January, when Cliff was

writing, than it might seem now in July.

From Houston, Jack Larks writes that he continues to work as a forensic engineer in human factors and ergonomics, construction safety, industrial safety, and product design. He has stayed in touch with other alumni in his locality, including Sid Atlas, '43, Greg Turner, '74, and Gilbert Godbold, '79.

I mentioned a few months ago that Charles

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691 CONCORD AVENUE CAMBRIDGE, MA 02138 TEL: (617) 864-7260 FAX: (617) 864-0779 Schwartz was angry at the University of California, from which he is retired, for reasons I did not know. A newspaper article filled me in: he objects to university-sponsored classified research, and he believes that its graduate schools are subsidized at the expense of undergraduate education by the misallocation of costs. The university administration studiously ignores his criticisms, which must really be infuriating.

I was saddened to learn of the death of Doug Haven last November 27. After leaving MIT, Doug worked as a sales representative for Du Pont and W. R. Grace, and for eight years for the MIT Alumni Fund. He became a self-employed financial planner and consultant 25 years ago. He had lived on Cape Cod since 1977, and was a member of the MIT Club of Cape Cod and the BMW Club of America. He is survived by his wife, Sally, a son, three daughters, and two grandchildren.—Richard F. Lacey, secretary, 2340 Cowper St., Palo Alto, CA 94301; e-mail lacey@hpl.hp.com

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My mail bag is almost empty and thus your ever vigilant, responsible, and (obviously) underpaid secretary would dearly appreciate a note (and/or a check) from any or

all of you, Pete Stark included. (More about him later.)

Bob Piper has his own business, Translog, launched in 1991 and focused on transportation and logistics consulting; but, according to Bob, he has mostly done freight bill auditing. As an avocation, he "fulminate[s] about government policy in transportation and land use. Would like to see government manage its [transportation] infrastructure entrepreneurially. Allow (compel) users to pay. Let these industries into the market system. Sisyphean endeavor but who knows?" As a footnote, I would add that Bob and I have traveled down the same "transportation economics" trail for many years, though to his credit he remained as a Berkeley, Calif., resident for many years more than I and is still there. . . . Sven Treitel spent the fall of 1991 semester as a visiting professor in the Department of Earth, Atmospheric and Planetary Sciences at MIT, noting that "this experience brought back many of the old memories (good and not quite so good)." He and his wife, Renata, are living in Tulsa where he previously worked as a research consultant with Amoco Corp.

Raymond Dietz is a charter member of the "Retirement is Great" Club (along with Gil Gardner and me), but adds that it "is a busy job!" Among his involvements are: commissioner for the Academic Quiz program for five counties and his home city; class agent for his high school; sailing; and traveling (most recently, a trip to Scandinavia). He now lives in Martinsville, Va. (just south of Roanoke), and formerly was with Du Pont Co. . . . Betty and Bob Godfrey proved their invincibility (among other things) by completing a threeyear circumnavigation aboard their 65-foot ketch about a year ago. And, to complete the saga, Bob reported that they acquired a 30foot motor home to escape Florida's summer heat and rain. Bob added, "[We] have sort of settled in Jupiter, Fla., where I play bad tennis and worse golf.'

Rocco Mancini is "holding the fort" in

Boston and continues to work for the Massachusetts Bay Transportation Authority (MBTA) as assistant director of design and construction for their three billion dollar program of expansion and renovation. Rocco added: "Will we ever catch up?" My answer: "In Boston? Never!" . . . Betty Ann Ferguson Lehmann has been serving as associate minister at the Federated Church of Hyannis (on the Cape) since fall 1982, just following her graduate work at Union Theological Seminary. To make life more interesting, she later studied at the Jung Institution in Zurich. Even better, her sabbatical in 1991 included trekking in Nepal and Thailand, followed by more study at Auburn Seminary in NYC. [] cannot resist asking: Who in the world would believe a ballroom dancer as good as Betty Ann would also be a trekker?] Finally, she described her daughers and sons (two of each) as, "Great kids!"

Presumably, most if not all of you know that Fortney H. Stark-that is, Pete, the Deke-is our only classmate in the U.S. House of Representatives and a key player in health care reform. [By now, both Pete and all of you know that I enjoy teasing him. Why? Because he sent the 40th Reunion Committee a million dollar check drawn on the U.S. House Bank but signed "You Know Who" instead of youknow-what.] But since Pete has not provided me with "notes on his doings," let me include some excerpts from this morning's Washington Post (3/23/94). After a 1955-57 stint in the Air Force and earning an MBA at U.C. Berkeley in 1960, he founded and became president of Security National Bank (in Walnut Creek, Calif.). The "Walnut Creek bank grew from a small storefront operation to a \$100 million financial institution. He sold his interest in it after his election to Congress in

Again, write early and often; otherwise I shall be compelled to write wonderful and long stories about my wife, children, grand-children, friends, doings, and misdoings.—
Martin Wohl, secretary, 4800 Randolph Dr., Annandale, VA 22003, (703) 354-1747

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Our 40th Reunion has come and gone—but this is being written in March. So, news of the great event will be found in future columns. In the meantime, we have a few

items of interest to tide us over... Charles Kalina has a new job: executive secretary, National Coordination Office for the Federal High Performance Computing and Communications Program in the Executive Office of the President, Washington, D.C... Stan Hoff reports that he has retired—with a bronze handshake... Tom Gibbs retired from Du Pont in early 1990 and is now working parttime as associate director of the Materials Technology Institute of the Chemical Process Industry. He works at home and has more time to enjoy travel.

Peter Arcidiacono has retired after 35 years with Sikorsky and United Technologies
Research Center. He is now into consulting and spending time with his three children and two grandchildren. . . . Harry Tayler retired last September. His son, he reports, is a gunner in the Israel Defense Forces Armored Corps. Harry's health has not been good for

SM '75

the past year, but he says he always feels better when his daughter and grandson visit from Dallas. . . . Perry Smoot does not report that he has retired; quite the contrary, he writes that he had an interesting trip to Europe last summer, cruising along the Rhine River and visiting Alsace-Lorraine. Then, in the fall, his son Frank was married. It is reassuring that not everyone has retired and that more than one of us are still traveling and having weddings. Good for you, Perry!

We are sorry to report that Frank Leeds died in July 1991. No other information is available. Our sincere sympathy is extended to Frank's wife.—Edwin G. Eigel, Jr., secretary, 33 Pepperbush Ln., Fairfield, CT 06430

As we write this, spring is

beginning to push its head above the ice and snows of a tough winter. As you read it, summer will be in full swing and you may be longing for some of the gentle cool breezes we are now enjoying. The seasons march on! Some of us have already entered the state of retirement (some gladly, some not so) and many others are contemplating it in the near future. How do you all feel about it? If you don't have major events to report-promotions, publications, honors-you may have enough time now to jot down your thoughts about these changes in our lives and how you view the next season. We're interested! Please send them in and we'll edit and filter judiciously.

Martin Shooman (Course VI) reports that he is now in his 37th year of teaching, consulting, researching, and book writing at Polytechnic University (Brooklyn Poly). His work is in computer science and electrical engineering, concentrating on reliability, fault-tolerance, and software engineering. Martin's wife, Sylvia, and he just celebrated their 31st anniversary. She teaches French at North Shore High School in Glen Head on Long Island. Son Andrew (MIT, mathematics and computer sciences, '85) completed a PhD in 1992 at Polytechnic University and is working on computer network reliability for Motorola/Codex in Canton, Mass. Daughter Alice (Tufts '89) finished her law degree at Yeshiva University in 1992, lives in Manhattan, and practices housing and family law for the Legal Aid Society in Brooklyn. Martin has been in contact with Gene Gavenman of Palo Alto, Calif., and Irwin Sterman of Spring Valley, N.Y., and he would be happy to hear from more of the old gang. His mailing address is: 12 Broadfield Pl., Glen Cove, NY 11542

Allen Wahlberg (Course XVII) is now senior VP for strategic planning and risk analysis with the Turner Corp. in New York City. He was previously senior VP and CFO. . . . Marsbed Hablanian (whose picture was inadvertently switched with some other lucky fellow in our April 1991 issue, corrected in July) has been named an honorary member of the American Vacuum Society (affiliated with the American Institute of Physics). He is planning to retire and do a limited amount of consulting (by choice) to keep mentally agile. He would also like to hear from "the select few" who still remember him. . . . Harlan Walker (Course X) is still struggling with hemochromatosis, which was not properly diagnosed or treated by his doctors, and is now suffering from myalgic encephalomylitis, diabetes, and high blood pressure. His wife, Gail, has still not found a replacement job for her previous career with Exxon, in the "coma-like California economy." Best wishes, Harlan.-Co-secretaries: Roy M. Salzman, 4715 Franklin Street., Bethesda, MD 20814; James H. Eacker, 3619 Folly Quarter Rd., Ellicott City, MD 21042

become senior vice-president of the Cannon Corp. in St. Louis, Mo. Merlin was formerly senior VP and managing director with the firm Stone, Marraccini and Patterson in St. Louis. ... Frederick Lupi has accepted early retire-

Merlin E. Lickhalter has

ment as a senior civil engineer from Rochester Gas & Electric Co., Rochester, N.Y. He is now working for Funnell Industries, an energy and recycling corporation. . . . Richard Kelly has become a senior executive vice president at Stone and Webster Engineering Corp. in Boston

Dr. Robert Brigham writes that his wife Dee (Deidre Davis, Wellesley '56) has a book, Imagery for Getting Well, published by W.W. Norton, coming out in April. It details the approach taken in the behavioural medicine program she designed six years ago for people with chronic and life threatening diseases, and includes the program's philosophy, implementation, and startling successes. . . . Joe Neville, professor of material science at Wentworth Institute of Technology, sent in some notes and observations of how well things are going with him.—Send news to Ralph A. Kohl, cosecretary, 54 Bound Brook Road, Newton, MA 02161

Please send news for this column to: John Christian, secretary, 23 Fredana Rd., Waban, MA 02168

Baseball spring training was just under way when we received a baseball card with a picture of Charlie Blaney pitching in a Red Sox uniform. And wow,

look at those stats! In his third season, he pitched a complete game with nine strikeouts and only one walk for the win to earn the "over-50 Cy Young award"! As you've guessed by now, Charlie was back for his third season at the Fantasy Baseball Camp with the Red Sox at Winter Haven, Fla. As he says, "My enjoyment of athletics, fostered by MIT, continues." Seeing the photo of Charlie taking a good full stride off the mound and looking fit at 5'11" and 160 lbs., it was just like watching him in action again with the Tech baseball team in '58. Like Yogi Berra said, "it was deja vu all over again."

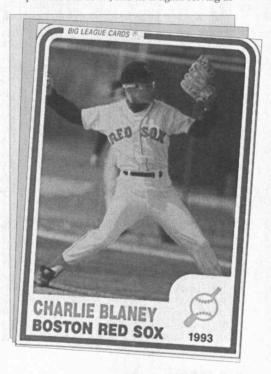
While phoning '58ers prior to the reunion, Matt Smith spoke with Sam Oolie, one of his Course III classmates. After graduation and the U.S. Army, Sam worked at

ClassNotes

Phelps Dodge and then "saw the light" and got an MBA at Harvard Business School. Next, Sam started a food service company, which succeeded handsomely. He sold the company to a British firm in 1985 and became a venture capitalist. One of his interesting ventures, Noise Cancellation, Inc., makes mufflers for internal combustion engines. They work by introducing 180° acoustical feedback; in buses, they reduce noise by 90 percent and improve efficiency enough to pay for the system. Sam also serves on the board of directors of Haifa University, and it was a meeting of this board that kept him from attending the reunion. He sends his regards to all and looks forward to the 40th.

Although Mike Kenyon told us at the reunion that he had just retired as regional engineer of the Denver & Rio Grande Railroad after 35 years of continuous service, he sent a note saying, "I am currently exploring new professional pursuits as well as doing family historical research. Gloria and I enjoyed the 35th Reunion at Prouts Neck, Maine, and we're looking foward to the 40th wherever it may be."

John McCarty received the Presidential Rank Award of Meritorious Executive for his work as director of the Propulsion Laboratory at Marshall Space Flight Center in Huntsville. He was recognized for his work in directing more than 250 engineers in the design of new propulsion systems and the operation of research and test facilities that provide experimental data from ground testing of launch vehicles, liquid and solid fuel rocket engines. John and Sandra have four children, and Sandy works as a physical therapist in an orthopedic surgeon's office. . . . At Temple University in Philadelphia, Richard Klafter has been a professor of electrical engineering since 1984. His textbook, Robotic Engineering, was published in 1989, and he is again serving as



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president of the IEEE Robotics and Automation Society. He holds patents on a heart-rate monitor and a touch sensor and has consulted for NASA, Sperry, Ford Instrument, and other companies. Richard and Marcia have two daughters and one granddaughter.

It is with deep sadness that we must report that Phil Friend and his wife, Judy, who had married just this past August, were returning to their Palo Alto home from the Monterey peninsula on March 24 when they were both killed in a head-on collision with a truck that crossed over the center line. Phil had been corporate contracts manager at Sun Microsystems since selling his own start-up company, Tek/Link, that provided computer training for businesses. Judy was an executive secretary at Stanford University Hospital, and she and Phil were both sponsors of the Monterey Bay Aquarium. An active member of the MIT Club of Northern California, Phil was slated to become the club president later this year. The club is establishing a scholarship in his name and will be pleased to accept donations.

The University at Stony Brook has created awards to honor its faculty and staff members whose work has had a significant impact on the university. Among the first group of honorees is James Simons, formerly a professor of mathematics and now chairman of Renaissance Technologies, an investment firm in New York. He has been chairman of the Stony Brook Foundation since 1988—Mike Brose, secretary, 75 Swarthmore St., Hamden, CT

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Chuck Staples definitely gets the prize as the outstanding Notes reporter, with a number of this month's items stemming from his efforts in contacting classmates as a part of

the reunion gift effort, and relaying their news to me. Many thanks, Chuck!

A nice letter from Adul Pinsuvana in Bangkok details a very active life. He became a grandfather last February. Spouse Malulee's third cookbook, Cooking Thai Food in American Kitchens-Book 3 with Garnish and Entertaining, came out in November, and comes with nine carving instruments. Her books, all on Thai cooking, have sold 120,000 copies since 1976! Adul continues: "I finished my contract with Siam Food Products in September. After talking with a few companies, I am undecided whether to continue working for someone else or on my own. I am giving myself until the end of the year to decide. At the age of 55, I can afford to take some time to think things out and not rush into a new job right away." Adul will be in the U.S. for the 250th! anniversery of West Nottingham Academy, his old high school, in June and hopes to make our reunion as well. He ends with the news that Bangkok has grown into a huge city-more crowded than Los Angeles and with many tall buildings, so that some streets look strangely like Manhatan. But it is still one of the best cities to visit, he says.

Bill Pitt is reported to be very upbeat about the recent and successful sale of his telephone business to a Texas firm. Now he's started a mail order pharmacy, Continuing Care Corp., to try to duplicate the Medco story. His son recently graduated from college and has joined Arthur Andersen. Bill hopes to make the reunion.... Another entrepreneur that Chuck spoke with is Paul Weinranch. In addition to his Dynamet Technology business, he and his wife have started Therapro, Inc., for mail order therapeutic products. Sounds like we are tracking the health industry pretty well!.... Kudos to Charles Hill, Jr., professor of chemical engineering at the University of Wisconsin, on his election as a Fellow of the American Institute of Chemical Engineers in 1993 and to Frank von Hippel for receipt of the American Association for the Advancement of Science Hilliard Roderick Prize in Science, Arms Control, and International Security.

A fascinating report on Joe Goodell, president of Outokumpu American Brass Co., who was married last September to Mary Ellen Hager. Four years ago Joe bought his own private railroad car which he named the "Dagny Taggart," for the heroine in Ayn Rand's Atlas Shrugged. He is coming to the reunion in this car, picking up many of his ATO fraternity classmates in Washington and arriving at South Station June 1. We obviously need pictures of this! . . . Bill Widnall called Chuck to to say that unfortunately he and Sheila (Sheila Evans Widnall, '61) can't make the reunion as they have been invited to Europe to the 50th anniversary of D-Day, June 6. Sheila, Secretary of the Air Force, simply can't decline, even for Bill's reunion. They report loving Washington; wind surfing and summer camping ventures keep them more youthful, perhaps, than most of us.

Shifting to the defense industry, we find two classmates who must be interested in the takeover of Grumman. Bob Polutchko on the corporate staff of Martin Marietta and Kent Kresa, chairman of Northrup Corp. Should generate some interesting stories by the time of the reunion, as both these class VPs have a shot at making our festive activities. . . . Walter Humann, chairman of Hunt Consolidation, Inc., reported a few months ago that he and his expanded family had all been scuba diving in the Cayman Islands, according to Chuck. Also while calling classmates in the fall, he caught Paul Ekberg, president of Birmingham Steel, just coming back from a Euro-

pean trip.

A note from Bob Schumaker reports that he is president of the Simulation Division at Evans and Sutherland, where he has worked for 21 years bringing real time computer images to training and engineering simulators. His systems are used in most airlines and are incorporated in the Army's new ground warfare systems. Bob is an active pilot with over 1,500 hours and "enjoys hiking and backpacking in (spare?) time."... Leonard Carr, Jr., writes: "My wife, Norma, had a nice visit with Al Engel and Brenda and Berry Altschul. It was good to tour the Institute, the crew house, and the sailing pavilion. Norma and I also were able to enjoy a beautiful weekend in Boothbay Harbour, Maine." . . . David Polak writes from Los Angeles that the investment management firm he founded in 1982, NWQ Investment Management Co., recently became affiliated with the Boston-based United Asset Management. A good environment and equity performance have contributed to a growth in assets to about \$5 billion! Sounds great!

With an exciting group of classmates like this, our reunion should be a bigger hit and more exciting than ever! Hope to see you there (or, rather, by the time you read this hope to have seen you there)! Again, I urge you to actually do it-send an update, which will be much appreciated by your classmates.-Dave Packer, president, 31 The Great Rd., Bedford, MA 01730, (617)-275-4056

35th Reunion

Were it not for a note from Alan Shalleck, this would have been a bleak news month

for your secretary. Please help me by sending a few words-perhaps on the card attached to your Alumni/ae Fund pledge. Al writes that he is living near Princeton, N.J., and has begun his third venture, Lifestyle 2000, Inc. Al is marketing unique therapeutic health care products directly to the consumer-the "products aimed at keeping one's lifestyle as high as possible for as long as possible." Al has married his high school sweetheart, and he and his wife have a home in Pittsburgh, Pa., as well as Princeton.

We have a new (the fourth) Class of '60 Fellow. She is Professor Isabelle de Courtivron, head of Foreign Language and Literatures. Professor de Courtivron's academic interests include French literature and women's studies. Like her predecessor Fellows, the \$40,000 stipend is intended to provide "flexibility to pursue new ideas and to move quickly when you see new opportunities of interest to you." Professor de Courtivron joins our 1993 Fellow, Professor Alan Brody, Director of Theater Arts. Incidentally, those of you who attended this year's Technology Day (chaired

by our class president, Jorge Rodriguez) may have seen Professor Brody demonstrating how the director's instructions affect the perfor-

mance of a play.

Finally, for you long-range planners, remember that 1995 is a reunion year-can't believe it's 35 already—and you'll be hearing from the reunion committee soon. . . . Hope you're all having a pleasant summer and have put aside memories of a long, cold winter .-Frank A. Tapparo, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

Huzzah! More grist for the class notes mill! Thank you all. Reed Freeman wrote that he retired from Union Carbide Corp. last September. He had been working with UCC for 32 years, having joined them a month after graduation. When he left he was president of UNI-SON Transformer Services, a subsidiary of UCC. Having conquered the world of technology, Reed enrolled in the School of Theology at the University of the South in Sewanee, Tenn. He is a postulant for Holy Orders in the Episcopal Church. He and his wife, Nancy, expect to be in Sewanee for the next three years. Where, you may ask, is Sewanee? It's about 40 miles east of Chattanooga off I-24. From the map, it seems to be an excellent place for contemplation! Reed says "returning to academia after three decades is a challenge,

Richard Kenefick has also stayed put -he has been in Washington, D.C., for 21 years. He and wife Gerri are both working for the

but a most enjoyable one."

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military: Dick for the U.S. Navy in its hovercraft program and Gerri in the Acquisitions Department of the Marines. They have been married for 33 years and have a 3-year-old grandchild, Kelly, and another on the way. And they look so young! . . . Ken Kotovsky writes that his "daughter, Laura (Course IX, '87), recently defended her dissertation in cognitive development ('Infants' Knowledge of Physics') and is now doing a post-doc at UCLA. Her husband, Ron (educated up the Charles River somewhere, class of '89), is a new faculty member in math at Harvey Mudd College. Our son, Jack (Course II, '90, SM '92), is at UC/Davis in the PhD program in biomechanics. My wife, Avis, is doing great work directing an ever-expanding program at the Pressley Ridge Schools that works with families in an intensive, but short-term, way to save kids from being institutionalized. When you first hear about some of the problems confronting families it sounds like impossible work (almost like Laura's learning that infants know some 8.01), but they have been having great success. I'm still on the faculty at Carnegie Mellon University in cognitive psychology-directing undergraduate programs, doing research in problem solving, and enjoying it immensely. And so it goes.

Howard Fine is doing fine. He is listed in ophthalmology in The Best Doctors in America! His specialties are cataract surgery,

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intraocular lens implantation, and refractive surgery. If you've got eye problems and you live near Eugene, Ore., you know where to go! ... Hank Liberman is an optimist (as opposed to an ophthalmologist). He writes, "I have come to understand that a layoff can sometimes be a blessing in disguise. After 19 months as an actuary at Allmerica Financial I have learned that work can be a pleasure and that Sunday nights are not to be dreaded. Having arrived at a good place in my work life, I want to now devote my formerly shackled energy to myself and my family. My wife, Elizabeth, is thriving in her career as director of the Office of Sponsored Research at Wellesley College and as assistant dean. My youngest child, Naomi, of whom I am envious, is postponing life by living and working in London until June 1994, after having graduated from Skidmore in May 1993. My middle child, Sarah, a 1989 Vassar graduate, is completing a graduate program in social work at the University of Pennsylvania. My oldest child, Robert, a 1986 Yale graduate, is completing a dissertation in political science at Harvard. He and his wife, Lauren Osborne, have been living in Princeton, N.J., for the past two years, where she is the history acquisitions editor of the Princeton University Press. So you can see there is much to which I can devote my atten-

John O'Connell is teaching at the University of Virginia, where he is H.D. Forsyth Professor of Chemical Engineering. For the last five years he was department chair, but is



Reuven Leopold

now on sabbatical at the University of Florida... Reuven Leopold was elected to the British Royal Academy of Engineering last November, the only American so honored! The English were impressed by Reuven's exceptional achievements in ship hull design and his work in hydrodynamics.

Last fall the Beverly [Mass.] Times had a long article about William Scanlon, who was running for mayor. Bill had spent almost his entire career for the United Shoe Machinery Corp. going from troubled subsidiary to troubled subsidiary curing them of their ills. Meanwhile the parent company kept changing owners. By 1987 it was owned by Emhart, which reorganized Bill out of a job. So, he decided to try becoming a consultant, based on his experience fixing broken companies. It is a modest success but doesn't pay as well as the old executive job. I've been trying to find out how Bill did in the election but haven't had much luck. As soon as I know I'll write

Richard Berendzen, who was the president of American University a few years ago, is the author of a new book, Come Here: A Man Overcomes the Tragic Aftermath of Childhood Sexual Abuse. . . . Bruce Tarter was appointed deputy director of the Lawrence Livermore National Laboratory last January.

I am sorry to report the deaths of two classmates. Robert Glass was stabbed to death in his Los Angeles home, presumably by a robber. Robert had a remarkable career in movies. He was a specialist in sound and won the Academy Award in his field twice: once for *The Exorcist* and again for *E.T.* He had over 200 film credits to his name and had been nominated for seven Oscars. There was general shock and sorrow in the film community. . . . We also just learned of Seymor Gordimer's death in May 1992.—Andrew Braun, secretary, 464 Heath St., Chestnut Hill, MA 02167, or via internet: andrewb820@aol.com or abraun@husc4.harvard.edu

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John A. Rollwagen has been named chairman of Plasma and Material Technologies of Chatsworth, Calif. John resigned as chairman of Cray Research in Minneapolis to

take a position as deputy secretary of commerce for science and technology in the Clinton administration. After experiencing the political hassles associated with his appointment hearings, he decided to return to private industry. We wish him the best of luck in his new endeavor in California.

George Meyer writes that he retired from the U.S. Air Force in April 1993 and now lives and works in Atlanta, Ga., where he directs a 20-person residency program in internal medicine. He and his wife, Lynn, love Atlanta, but they miss being able to travel around Europe as they did for the last three years with the USAF while stationed in Germany. Their son, Bob, now 24, works for Prudential Securities in San Francisco. Daughter, Liz, now 22, teaches French and cinema at Northwood School in Lake Placid, N.Y. Their third, Dobro Goodale, his cousin's son, graduates in June 1994 from the University of California/Santa Cruz in clinical psychology.

Received an e-mail bounce from the MIT Alumni/ae Office for John Rourke, who has been put on the MIT1962 e-mail list. John was inquiring about classmate Wally Couch, who is still living in the state of Washington, employed as president of Three Systems, Inc. It seems that the MIT Alumni/ae Office will answer e-mail inquiries about our classmates, and that they are exploring other potential services for MIT Alumni/ae via the Internet and other telecommunications services. Naturally, the Alumni/ae Office will keep your information confidential if you request it to be kept so. Classmates can contact JBLAKE@MITVMC.MIT.EDU with inquiries about e-mail services existing and contemplated.

Received an e-mail message from Elwyn Berlekamp last December, and wanted to put it in last month's Class Notes, but misplaced my hard copy until earlier this month—so here is the news from UC/Berkeley. In addition to assorted adventures as a researcher at Bell Labs, a professor of electrical engineering, computer science and/or mathematics at UC/Berkeley, an entrepreneur, a Kodak executive, a money-fund manager, and two recent years as a visiting professor at MIT (1991-1993), Elwyn recently finished writing a book entitled Mathematical Go. It demonstrates how a new kind of mathematics yields decisive strategies for difficult late-stage endgame problems in Go, the classical Asian board game. David Wolfe, who received a

PhD as Elwyn's student at Berkeley in 1991, is the coauthor. The book is available for all you Go fans from: A.K. Peters (Wellesley, MA), e-mail address: kpeters@geom.umn.edu or fax phone: (617) 235-2404. Elwyn also cowrote, in 1982, a two-volume book on the mathematics of combinatorial games, entitled Winning Ways, with co-authors John Conway and Richard Guy. That earlier work is still available from Academic Press. Winning Ways addresses many simpler games, including Dots and Boxes, which Elwyn recalls fondly from "the good old undergraduate days at MIT!"

I note that classmate Bill Koch, following his success in the last America's Cup, has indicated that he might sponsor an all-women team entry in the next America's Cup event. This was mentioned in a recent (March 1994) article in the New York Times. Bill has also been the prominent figure in reorganization events at Kendall Square Research Corp., where he serves as chairman and acting chief executive. Bill and other investors are providing the capital to permit Kendall Square to settle a dozen shareholder lawsuits and to get on with the business of developing supercomputer technology. Bill is quoted: "I'll be in control of this company for a while.... My intention is to make it into something we can all be proud of!"

If you have access to the Internet, please put a message through to: <mit1962@mitvma.mit.edu>. Alternatively, you can send a message directly to me at: <uabnm01@asncube.asc.edu>. Otherwise, please send your news and personal notes to: Hank McCarl, secretary, P. O. Box 352, Birmingham, AL 35201-0352

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Please send news for this column to: Shoel M. Cohen, secretary, Dept. of Psychology, Nassau Community College, Garden City, NY 11530 or email: Internet

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As I write, it's March; as you read, it's June, maybe July. In between, hopefully many of you will have had the opportunity to enjoy a return visit to Cambridge to celebrate our

30th Reunion. I hope that a good time was had by all.

Among those anticipating attending were Sue and Herb Norton, who prior to the Reunion sent in an update with their class dues. Herb earned a PhD from Columbia University in 1969 and is now a member of the technical staff at AT&T Bell Labs in Naperville, Ill. (email: hon@uscbu.att.com). Herb and Sue were married in January 1993 and, in addition to their daytime jobs (Sue is with the Valspar Corp.), they teach evening dance classes at a local community college. Among their specialties-ballroom dancing, round dancing, and country & western dancing. Herb's two daughters from a previous marriage, Heather and Claire, are going into their senior and sophomore years at the University of Illinois and Marquette University, respectively. The Nortons are living in Glen Ellyn, Ill.

Another Bell Labs classmate was quoted in

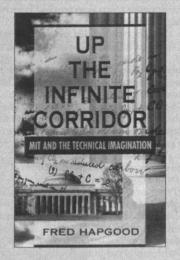
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a November 1993 article in *Business Week* about computers that are "finally learning to listen." Larry Rabiner, described as "a prominent speech researcher" in Murray Hill, N.J., talked about the willingness of humans to forgive errors in speech-recognizing computers as long as the computer is able to maintain a dialogue that is moving forward.

I had a delightful phone conversation with Jerry Weiner, who called in December to wish me a happy (divisible by 10) birthday. Jerry and his wife, Sylvia, are still active in and enjoying the high-class end of the travel business. Jerry followed up the call with a copy of the itinerary for a group tour to South Africa, Botswana, and Zimbabwe that their Fort Worth-based company (Travel Management International) is planning for this summer. The tour sounds absolutely spectacular.

Alumni/ae Fund notes are the source for the next four items. Don Cameron reports that he and his wife are "gradually getting three kids educated." A son, 21, was in his senior year at UC/San Diego; a second son, 19, was a freshman at UC/SD; and a daughter, 15, was a high school freshman. The five Camerons had just gotten back from a "fabulous" cruise to Mexico. Don is still with IBM but is starting to think about his "post Big Blue" career. His wife is with H&R Block and likes it; Don describes her job as "not too taxing." He is still involved with musical activities and would

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Observing the Universe

lot goes on in what we think of as empty space," says George Smoot III, '66, in a recent interview in Omni magazine (March 1994). He paints a picture of the expanding universe: imagine galaxies like dots on a balloon, and as the balloon is blown up, the galaxies fly off in all directions due to the increasing space. He describes space as flexible, stretchable, and having real substance.

Smoot, a research physicist at the University of California's Lawrence Berkeley Laboratory, headed a team that collected data from detectors aboard the Cosmic Background Explorer satellite (COBE)—data that strongly support the Big Bang

In addition to putting the Big Bang on a firmer footing, the COBE information shows that space is about ten times more homogeneous than previously thought. "No manmade thing, not even a billiard ball,

is anywhere near that smooth," says Smoot. COBE also brought back a surprise: the universe has tiny wrinkles or irregularities. So, while confirming prior theory, COBE has brought back more puzzle piecespieces that Smoot and his colleagues plan to pursue.



love to hear from any classmates. . . . David Moran is presently director of Industrial R&D Programs at the Office of Naval Research in Washington, D.C. His son, Scott, is a navy lieutenant and jet pilot. His daughter, Lindsay, is a graduate student at Columbia University.

Bud Boring sends greetings to all; he got 1994 off to a good start with a new job as CFO of Wellcare S.A., a new company formed to deliver telemedicine services from Massachusetts General Hospital to hospitals in the Middle East and elsewhere. Bud looks forward to frequent business trips to Mass General from his home in Paris because they will give him the chance to see friends in the Boston area. . . . Jim Rome has been in the Fusion Energy Division of the Oak Ridge National Laboratory since leaving MIT with a PhD in 1971. He has been studying the containment of charged particles in magnetic configurations and is a strong advocate of stellarators. (He publishes The Stellarator News.) Jim also started his own company, Scientific Endeavors, which sells a scientific graphics library for PCs. For the last 21 years, he has served on the Educational Council.

Finally, while scanning a recent copy of Louise's Harvard Business School alumni/ae magazine, I came across a column written by Ron Frashure, who serves as secretary to his 1970 B-School class. I quote from two paragraphs in his column. "I have not had as much time this year as in the past to seek you out and solicit news from you, for two reasons.

First, the (Boston-based) investment management firm where I am a principal, Acadia Asset Management, has expanded its investment horizons to include 20 or so emerging equity markets around the world along with 20-some developed markets in which we have been active for some time. As we have expanded our research horizons in these new markets, I have been traveling extensively outside the country this year. So far I have spent six weeks outside the U.S. on business in 1993, spending considerable time in Chile, Argentina, Brazil, Russia, Ukraine, Japan, Taiwan, Hong Kong, and China.

"The second reason why I have not been contacting you as often is a more difficult and personal one. Over the last year, especially since November 1992, my wife, Roberta, has suffered a major relapse in her physical condition as a result of the progressive action of multiple sclerosis, which was diagnosed in 1982. She has been hospitalized three times this year. She has given up her medical practice and is having considerable difficulty getting around. Because of these developments, I am trying to spend as much time as possible with our two children, who are still at home, and attempting to keep things going as I play what is essentially a single-parent role.'

Best wishes to the Frashures as they all struggle through tough times. I have a wonderful brother-in-law who is afflicted with multiple sclerosis and it is certainly one of the most frustrating and agonizing diseases that I

know of. The saddest and most unfair part is that based on what I've seen, the disease seems to attack the nicest people in the world. Let's hope that sooner rather than later there will be cures for MS and other such diseases.-Joe Kasper, secretary, R.R. 2, Box 4, Norwich, VT

30th Reunion

We'll start with a reminder-30th Reunion will be one year from now! If you're (1) inter-

ested in helping, (2) have special ideas for events, or (3) want to send a message to a group to convene, just call. I'll be glad to put messages in the November/December and Jan-

uary issues.

Class secretaries take almost any excuse to meet a new contact. Recently I called Steve Grodzinsky at the suggestion of his brother Alan Grodzinsky, '63. I had met Alan recently when he licensed a patent to Gel Sciences. Steve is head of the Computer Science Department at the University of Bridgeport, and reports that MIT is in the family blood, with his daughter Rachel having graduated in 1992 and the impending graduation of his son in 1994. Steve is active in the MIT Club in New Haven, where he lives.

Jim Young called with an update on his career and home life. Jim was at Stanford for 20 years, and then moved in 1990 to Rice University. He attended high school in Houston and his father is still living there, although he says that wasn't the primary reason for the move-he says he preferred the smaller, more student-oriented atmosphere at Rice. Jim continues to work in lasers and optical devicesone focus is very-short-wavelength UV lasers for high resolution imaging (surfaces, biological materials, catalyst studies, etc.) and the other is multi-plexing in fiber-optic communications using multiple wavelengths of light. Jim continues to try to keep two old Porsches running (a 1958 model he's had since 1971 and a 1965 convertible). He and his wife enjoy cooking and often entertain students at their

Andy Tanenbaum writes from Amsterdam that he is now the first dean of the Vrije Universiteit Graduate School of Computer Science. Sounds like he backed into the position after having worked within the university to get their first computer science graduate program going and was dragged into the role of dean.

Had a great conversation with David Waltz, who moved down to Princeton last July to be the VP in charge of the Computer Science Research Division of the NEC Research Institute. David had been with Thinking Machines. He will keep an adjunct teaching position at Brandeis. The NEC charter is basic research targeted 10-15 years in the future, including massively parallel systems, optical interconnects, neural nets, computational neuroscience, and vision.

David's wife seems to have made the move well, and is reestablishing her pottery business in New Jersey. He reports his daughter is a senior at Wellesley and his son a freshman at the University of Massachusetts in Amherst. His job involves a lot of travel, taking him regularly to Hong Kong, Tokyo, etc.

At the applications end of large-scale computing is Art Bushkin. Art is now president of a Bell Atlantic subsidiary that is leading in building the information highway. His business is the "Stargazer" program. Art came to Bell Atlantic in July 1992 after a lifelong career in consulting in the information services area. He has run his own consulting firm twice, and sold one of them to A.T. Kearney, where he worked for several years. Art says the real issue in building the information highway is getting started with a system that can handle all the transactions-millions of them—that happen at once. The bandwidth is adequate to move the data and video, and the consumer-end alternative technologies are reasonable-its the massive number of actions that can be going on simultaneously that's the

On the domestic front, Art and his wife of 22 years have two children, Michael (9) and Rene (11). Kathy is the CAO for the News activities of U.S. News and World Report.

Wayne Thurman has moved to Pennsylvania to run Rust Remedial's NorthEast Division (East from the Dakotas and North of the Mason-Dixon line). Rust, a division of WMX, is involved in new construction, encapsulation, and thermal desorption around major environmental sites.

Richard Freedman writes that he is back to his old card-playing interests, but declined an invitation to the 1994 American Cribbage Congress Tournament of Champions because he was performing in a show with the MIT Gilbert and Sullivan players on the same date. He has been following a fervid interest in G&S, and is currently the president of the New England Gilbert and Sullivan Society. Richard hopes to make the Reunion next year-he missed the 25th, having lost his wife to cancer shortly before. In real life he is a programmer for a defense contractor .-George McKinney, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 232-

Joseph Dickey has been appointed COO for the Tennessee Valley Authority. He has 26 years of experience in the electric utility industry, the first 24 with Florida Power and Light. While at FP&L he was extensively

involved in the development of the



Joseph Dickey

total quality management system for which FP&L received the Deming Award in 1989. He joined the TVA in 1991 as senior VP for Fossil and Hydro Power with responsibility for 40 plants. He and his wife, Constance, have three children.... Ralph Schmitt has just settled into a new home in York,

Pa., and invites any classmates in the area to come visit. One of Ralph's goals in the class reunion yearbook in 1991 was "earthquake avoidance." Did recent events prompt the move from California? . . . I received a delightful letter from Tom Scott. He has left Lucasfilm's Skywalker Sound division after seven years there as director of engineering to start a new company, the Entertainment Digital Network (EDnet). The company uses digital fiberoptic phone lines to interconnect entertainment business executives, talent, service providers, and clients so they can exchange high-quality multi-media materials. You may have read about the company in the Trends section of Technology Review earlier this year but not realized it was our own Tom Scott being cited. In an article in the New York Times, record producer Phil Ramone predicts this technology heralds the end of the tradition of dozens of performers gathering in one place to take months to record an album. Instead, the artists will contribute from their own studios, with their own equipment and their own musicians; no more arranging things around conflicting schedules or sending master tapes from studio to studio where they can be easily damaged in transit. We wish Tom and his fledgling company much luck.-Eleanore Klepser, secretary, 84 Northledge Dr., Snyder, NY 14226-4056, e-mail:vismit66@ubvms.cc.buffalo.edu

Jeff Wiesen has been named president of his Boston law firm, Mintz, Levin, Cohn, Ferris, Glovsky and Popeo. Jeff notes that he went to the Institute planning to get a degree in management, and although the route was circuitous, he seems to have arrived at the originally planned destination. For the past five years, he has directed the Mintz Levin Biotechnology Law Group, and he represents the firm on the Biotechnology Industry Organization and the Massachusetts Biotechnology Council. Jeff and Elaine live in Lexington and

have 23-year-old twins. Daryl is a law student at Yale, and Rachel is a teaching assistant in Lexington. Mintz Levin employs more than 200 attorneys at offices in Boston and Washington, D.C.

George Nybakken is still working at Uniroyal Chemical and living in Middlebury, Conn.... Gerald Tomanek is in his eighth year running Bedrock Capital, a conservative and rather quantitative money management firm. The Tomanek nest will soon be empty, and they will have the opportunity to relive the agony and ecstasy of college, but vicariously this time.—Sharlotte and Jim Swanson, co-secretaries, 878 Hoffman Terr., Los Altos, CA 94024

The most exciting news this month is that you can now reach us the high-tech way via Internet. If you know what this means you can use the address mmarcus@fcc.gov-if

you don't know what this means, I suggest you rush to your neighborhood library or bookstore before your children realize you're behind the times. . . . Steve Finn and Ken Theriault represented the class on February 4 at a lunch in President Vest's house to announce the new MacVicar Fellows. Professor Ole Madsen, ScD '70, of Course I is being supported with the funds we raised as our reunion gift. The fellowship will pay part of his salary,

ClassNotes

remove the need to meet part of the salary through research grants, and will support developing ways to enrich the undergraduate learning experience. Professor Madsen has been at the 'Tute since '72 and has retired the Course I teaching award. As part of his acceptance remarks he described his frantic efforts to eliminate cigarette smoke in his office with a can of Lysol before Provost Mark Wrighton came to announce his appointment. He then pledged to give up smoking for the duration of

his appointment.

The letter of the month is from Tim Kjellberg and will be given in its entirety: "1993 (was) filled with aviation enjoyment. Throughout the spring and fall I've looked at the earth from new attitudes-from a Great Lakes open-cockpit biplane. Even flew in a number of aerobatics competitions. The summer was highlighted with a flight to Alaska. Three planes with all our camping and survival gear and mountain bikes. This is the best way to see the majesty of our land. Visited briefly with Dennis Kalla, '67, at his home in Philadelphia during August. The year ended with more flying, including a win in the Phoenix 99's Kachina Doll Air Rally with a special friend (scored 99.7%)."

For John Swaim it's not "Goodbye Columbus" but the opposite. He has moved from Xerox to Cummins Engine Company in Columbus, Ind. . . . In East Orange, N.J., Jennifer Rudd has a private practice in internal medicine and gastroenterology. Her daughter, Meena, is now 14. . . . Abby and Art Kalotkin were married in 1986 and their son, Charles David, is now $1^{1}/_{2}$. They are still living in Brookline, where Art manages real estate. His leisure-time activities focus on travel and photography-work for nonprofits and baby pictures. . . . Last year Morry Markovitz's book about zero coupon bonds, How to Beat the Street with PLAN Z, was published by John Wiley. . . . Out West, Joel Robinson is now director of environmental sciences for Unocal in L.A. Previously he was manager of Unocal's Geysers Field geo-steam 2000 MW electric project north of San Francisco. . . . Russell Mersereau is "still" Regents' Professor of EE at Georgia Tech. . . . Last year Darryl Pomicter joined US TeleCenters as VP for Operations and moved back to Beacon Hill from Cambridge. His sons, Ed and Ben, have graduated from Marlboro College and Har-

That's all we have for this month. We look forward to hearing from you. Remember that the "class store" still has reunion yearbooks for \$25 and T-shirts for \$15.—Gail and Mike Marcus, secretaries, 8026 Cypress Grove Lane, Cabin John, MD 20818, e-mail: mmarcus@fcc.gov

vard.

You are reading these July notes shortly after our class convened for its 25th Reunion. I can no longer exhort you to attend! As I prepare these notes, the deep winter snow is half-melted. It is late March, shortly after the fifth anniversary of you-know-what: the Exxon Valdez grounding and a strange announcement from Utah.

Mike Laird writes from Devon, Pa.: "Had a terrific vacation to the southwest-visiting Anasazi Indian ruins, Meteor Crater, the Grand Canyon, etc. I've taken up rock climbing in the past year and do 5.8-level climbs. Would appreciate contacts from other MIT rock climbers."... Ron Lau sent this missive from Sunnyvale, Calif .: "I live with wife Ginny and three children. Have staved in SF bay area since graduation. Currently work for Octel Communications as software manager. Regularly see other MIT Phi Sigma Kappa brothers in this area."

From Ron Beatty, a nice letter: "I was part of the incoming class of '69 although I graduated in 1970. My best friends were in the class of '69, so I am writing to you.

Foremost on my mind is DTYD, Burton House's third-floor annual party. All former residents of Burton 3rd are invited to this year's 25th DTYD celebration on April 15-18 at Burton House. I will be there with Greg Gowdy, Rich Rosen, '70, and Ed Moore, '71. Rich Heldt, '67, and Dan Bloom, 72, say they'll see us there. Many more oldies but goodies are expected.

"I am now a software engineer for Maxon America, Inc. (816-891-6320), located near the Kansas City International Airport. I've retired twice already to increasingly comfortable levels of poverty. Next retirement is scheduled for 1997 or earlier. I've enjoyed hiking and camping in 25 of the 35 National Parks. I encourage everyone to spend as much time in these treasures as they can. I still ride motorcycle, play basketball, etc. 'Still crazy after all these years.'

"Best wishes to everyone . . . and thank you, Eugene, for performing a valuable service to us all."

The Letter of the Month comes from Herb

'It does seem incredible that 25 years have passed so quickly. So many of the wonderful happenings at MIT are still fresh in my mind: Professor French's 8.01 lectures, Jerry Lettvin's famous debate with Timothy Leary, Professor Zacharias's seminar on science and politics, all the varied and marvelous extracurricular activities, from sports to beer blasts to afternoons at the BSO. Do you remember where you were during the Great Blackout of 1965? I was on the Charles at the time, working out with the lightweight crew and wondering if illegal hotplates were the culprit. Although I've had many remarkable experiences since graduating, I look back on my four years at MIT as unique and irreplaceable.

"It may be of interest to some of our classmates that as one of the first MIT students to take classes at Wellesley College, I had the opportunity to become acquainted with our current first lady. My recollection of her does not jive [jibe?] with any of the more sensational theories of her personality; she came across as an exceptionally intelligent, thoughtful individual who was not in the least dogmatic or ideological.

"After graduating from MIT I tried many different things, living, working, and traveling all over the world. I spent some time in Europe, mostly France and Spain, and then went to Israel, where I lived for three years. The recent movement towards peace between

Israel and the Palestinian people is something I never expected to see in my lifetime. Truly we do live in remarkable times.

"Family responsibilities brought me back to the U.S. in 1974. My mother died early that year and my father two years later. The need to find gainful employment pushed me away from my hope to become a practicing scientist into the more lucrative area of software engineering, where I have remained since. The phenomenal changes in this field have made me even more grateful to the Institute for the intellectual preparation I received there.

"In 1980 I had the choice to work in Japan for one year, which was the beginning of a deeply rewarding involvement with Japanese society and culture. Since that time I have tried to put into practice many of the things I learned from my Japanese colleagues. It was clear to me back then that the Japanese work ethic, their obsession with quality, and more importantly their acceptance of individual responsibility for the quality of their work would make them the formidable competitors they have become. I regard with a combination of amusement and despair much of the popular thinking in this country which attributes Japanese economic success to a variety of 'unfair' trade practices. The Japanese spent a century learning from the West; I hope we have the wisdom to learn from them.

"After returning from Japan I settled in the Boston area, where I met and married my wife, Phyllis Hirsch, a part-time ballerina and full-time educator. We are now the parents of two children, Jonathan (9) aka JJ, and Sarah (6). II has his heart set on MIT, and if the Institute ever offers a major in video games, he is sure to be accepted. Sarah's interests are somewhat broader, but she too enjoys her time with Sonic the Hedgehog.

"I've had a number of interesting work experiences, including cofounding a company producing database software. The company was successful in its market niche but was eventually acquired by one of its competitors. Nonetheless, the experience of starting a business taught me many valuable lessons. Later, I had the good fortune to work for Sybase, my present employer, which specializes in client/server database software. It has been a great place to work.

"For the time being, that's all folks. If anyone would like to get in touch, you can send me e-mail at Herb.Lison@sybase.com, or at 409 Highland St., Newton, MA 02165."

That's all the notes for now. Now back to my demanding responsibilities as editor of Cold Fusion magazine at Wayne Green, Inc., in Peterborough, N.H.-Eugene F. Mallove, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

25th Reunion

Bill Michels is senior VP, senior partner, member of the board of directors, and member of the operating council of Booz Allen & Hamilton. He assists computer and electronics companies in areas of business strategy, marketing, product development, and turnarounds. . . . Mark Snyder continues teaching at Fitchburg State

College. . . . Gail Willsky, an associate professor of biochemistry at the University of Buffalo, has been lecturing on gender inequities in the sciences.

After recovering from the XXVth Drink Till You Drop celebration, originally started on Burton Third, Greg Gowdy writes that he and his wife, Donna, hope to see many old friends at the 25th class reunion.-Greg and Karen Arenson, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

Please send news for this column to: R. Hal Moorman, secretary, P.O. Box 1808, Brenham, TX 77834-1808

Help, send news, we are really short this month! Kenneth Cooper has been appointed president of Pugh-Roberts Associates, the Cambridgebased division of PA Consulting Group. They do consulting on defense, telecommunications, utility, banking, oil, and healthcare industries, and are composed entirely of MIT alumni/ae. Ken was recently named overall winner of PA's top Thought Leadership prize for his published article series, "The Rework Cycle: Why Projects Are

And that's it for now. I'm heading to Thailand and other points east, and hope that when I return I will have lots of news awaiting me from all you classmates to include next time.-Wendy Elaine Erb, co-secretary, 6001 Pelican Bay Blvd, Apt. 1001, Naples, FL 33963

Mismanaged."

Tom Lydon is wondering if anvone from the '73 hockey team is still playing regularly 20 years later, particularly Matt Goldsmith, Steve Book, Mike Schulman, and Rob

Hunter. Tom hasn't played on a regular basis for about nine years now but yearns to be back on the blue line. Other than that, little news; he is still managing a department of 100 engineers providing the computer facilities for the development of the Patriot missile.

James Snell recently returned from a sabbatical in France at the Institut des Hautes Etudes Scientifiques, doing work on dynamic system simulation. . . . Alan Lehotsky is now VP of technology at Open Environment Corp. in Cambridge. . . . Willy Shih is a VP of Alpha Personal Systems, at DEC.

That's all, folks!-Robert M.O. Sutton, Sr., secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

I hate long goodbyes and this column is going to reflect that. For 15 years I've been Your Faithful Scribe. Now it's time to pass that mantle on to someone else just as

Faithful. It has been an honor to write this. I've felt complimented with every letter people sent me. I've felt pride with every honor I reported you received. I felt excitement and awe with every birth announcement. I felt loss with every passing. There is so much among us of good and value and it has been fun being able to report it. Carry on.

Peter Dietz reports on his Twentieth Anniversary Reunion contribution envelope that he's left GE after 18 years to become VP for technology with the Controls Group of Johnson Controls, Peter and the kids find Milwaukee colder than Louisville but the kids love playing in the snow. . . . Stephen Jay Gould received Sigma Xi's highest award. the William Proctor Prize for Scientific Achievement. The Proctor prize recognizes outstanding research and the ability to communicate its significance to scientists in other disciplines. The award was presented in April at Sigma Xi's 1994 Forum in Atlanta. . . The Alumni Association reports the passing of classmate Tom Vasak last year.

Brymer Chin penned his first letter to me in January. In it he talks about his years at Tech, the Non-Resident Students Association, Joseph Fernandez, and the first 20 years of his career. Brymer received MS and PhD degrees from the University of Illinois and went on to work at Bell Labs. For almost a decade, life was fruitful, but in 1989 he was caught up in the new "spirit" of "downsizing" and "re-engineering the corporation." He wonders about the others out here in readerland who are struggling while companies become "lean and mean" and how are we all holding up? How are we all holding up indeed. We are

held up by the love of God. That has two meanings. Both of them are true. I'll leave you with that.—Class Co-secretaries Lionel Goulet, 115 Albemarle Road, Waltham, MA 02154-8133 and David Withee, 1202 Linden Dr., Mt. Pleasant, IA 52641

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20th Reunion

Apologies for missing my last couple of columns. Here is the news (or, in some cases,

the not-so-news): Bruce Miller wrote (in November of last year) that "after numerous detours, delays, and dead ends, I have finally completed a PhD in physics (at the University of Illinois). The last of my advisors was fellow East-Campuser Costas Papanicolas, '72." . . . And this from Carol Livingstone: "Still am director of the Division of Management Information at the University of Illinois in Urbana-Champaign. I garden in my spare time, and won several ribbons at last years's county fair for my flowers. My oldest son, Paul, has now exceeded 6 feet tall at age 13 and a half." She also noted that she "occasionally sees Bruce Miller around the U. of I." . . . Arlo Weltge dropped a line to say he is in an old house at a new address (5213 Valerie St., Bellaire, TX 77401). His son Fred is 4, and daughter Eleanor is 2. His wife has been in practice for a year as a hematologist-oncologist. Arlo is an assistant professor of emergency medicine at the University of Texas-Houston Medical

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School. He is also the president of the Texas College of Emergency Physicians. He says he would like to hear from Rufus, Glen, Jon, and Guy.

This year David I. Katz came to Boston for the Friends of MIT Crew Dinner and Head of the Charles race. He had "beautiful weather for the spectacale." He also had this to say, "Karen will be student teaching by the time this gets printed. She also organized a nonviolent, multicultural (Unity Sing) in response to a rally by the KKK and [neo] Nazis. Quite a hectic event!" . . . Leonard J. Weiss is a psychiatrist in the Chicago area. He published a paper in the International Journal of Geriatric Psychiatry, "Psychosocial Treatment of the Geriatric Patient," Vol. 8, No. 1 (January 1993). (Now you can see how behind I am in my column writing!)

Joel T. Voelz writes, "After seven years in the CAD (computer-aided design) software arena with Autodesk I decided to turn my attention to the consumer market. I left Autodesk in April after stints as director of marketing and general manager. While looking for a multimedia/edu-tainment/consumer company to join and/or start, I have been consulting for game and education software firms and helping a new start-up get venture funding." . . . Russell S. Phillips sent a note

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to say that he is in the Division of General Medicine at Beth Israel Hospital (in Boston, I presume) where he practices, teaches, and does research. He and wife Elise have three children, ages 5, 7, and 10 (Zeke, Jeremy, and Adam). Elise is a health educator at Beth Israel.

Mark D. Beasman, formerly the director of financial planning of the Marriott Corp. in Washington, D.C., is now vice -president of finance of Marriott Health Care Services in Avon, Conn. . . . Jeffrey Moore has been



Jeffrey Moore

appointed chairman of ColorAge Inc. He had been president since the company's inception in 1986. Based in Billerica, Mass., ColorAge Inc. is an international company which specializes in digital color printing and imaging solutions for the corporate and graphic art markets.

That's it for now.

Thanks for your patience awaiting this column. Keep in touch.—Jennifer Gordon, secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036, or 18 Montgomery Place, Brooklyn, NY 11215

From Richard Jamison: "My wife, Beverly Ross Jamison, '75, and I shall be serving as educational counselors in the Northern Virginia suburbs of Washington, D.C. Beverly is in her second year teaching computer science at Marymount University in Arlington, VA. I shall be retiring from the Navy this coming summer. I am currently managing the design of submarine propulsion components."... Jean B. Hunter writes: "We had a new daughter, Suzanne Midori Hunter Hirasuna, born April 29, 1993. Tom started working at the Food Network, an Ithaca, N.Y.-based firm for the food industry—position is senior project engineer."... Michelle Petrofes has "eight years on the Oregon Coast and we are busier than we really want to be. This year brings a big change to our practice as we are recruiting a family doctor to replace two who retired or entered academics. Abigail, 8, and Patrick, 5, have lots to do and this keeps us from being submerged in medicine."

From Jeslie Chermak: "It has been a busy year. It started with my marriage in April to Joy Morris and stayed hectic with a year-long do-it-yourself kitchen remodeling. Now we're taking a month off (January) to scuba in 'Oz'-very appropriate for two folks who first met on an April Fools' dive trip!"... Bonnie Biafore has finally written! "Since graduation I have spent four years getting a master's in structural engineering and discovering I did not enjoy the life of a structural engineer. I then spent the next 11 years getting into CAD and gradually moving to application development, project management, and even account management, a long journey when one begins in the architecture school. Now, I am beginning to get involved in multimedia and the MIT Media Lab and its progeny beckon. Home at last!"

A fax from Steve Lubar: "I've been at the Smithsonian Institution for more than 11 years now, curator of Engineering and Industry at the National Museum of American History. This year, my book InfoCulture: The Smithsonian Book of Information Age Inventions was published by Houghton Mifflin. It's a history of communications, entertainment, and information processing technology and how they changed American culture. I'm hoping it will be a best seller. Everyone should buy several copies; it makes a great gift. Other projects last year included a small exhibit on the history of factory labor and management, and work on a very large exhibit on American history and culture that will open this summer in Tokyo. It's called the American Festival Japan '94, and will be at the Mhuhari Messe exhibition center from July 8 through August 31."

Your secretary had a nice phone conversation with Dan Christman. Dan is still at Rohm and Haas in Philadelphia, and having an interesting and enjoyable time:

As for your secretary, I continue to remain very busy dividing my time among family, my computer business, and trading. While working on a project in Boston, I informally dropped in to see the 'Tute. Everyone looks so very, very young! And busy. The infrastructure is nicer, and some students were very helpful in giving me a tour of Project Athena. I strongly recommend that if you have a chance to drop in, you should. The 'Tute, like we members of the Class of '76, improves with age!

Finally, please remember to write, phone, fax, or e-mail. We need your news—and you have a variety of media channels by which to reach me.—Arthur J. Carp, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523; Tele: 516-295-3632, Fax: 516-295-3230, e-mail: quantalyt@aol.com

Please send news for this column to: Ninamarie Maragioglio, secretary, P.O. Box 10315, Burke, VA 22009-0315

The Class of 1978 Scholarship Fund continues to benefit students each year. We've received information about the two students who were chosen as Class of 1978 Scholars for the 1993–1994 school year.

Both were scheduled to graduate this May (the Class of 1994—16 years after 1978!) We wish them all the best in their future endeavors. Shannon Moynihan will receive double degrees in biology and aero/astro,

and was planning to start medical school in the fall at Yale or Harvard. Shannon was active in her sorority and other extracurricular activities. Paul Hsiao will receive a mechanical engineering degree and was interviewing with biomedical firms for a product design position. He hopes to work in either New York City or San Francisco. Paul's UROP research involves bioartificial livers. Paul joined MIT's formula car racing club this year, and did volunteer work as an English teacher for the Chinese Civic Center in Boston.

wo of the many intriguing

by Steven Lubar, '76 (see

author's description of his

illustrations in InfoCulture

book to the left of the jacket).

The cartoon's caption reads:

ment to that particular

"I feel a sentimental attach-

button—it does the job

I did when I first came

here." Below: The secret

of the 1879

expert chess

player was

hidden inside.

automaton

was simple: an

chess-playing

Your donations to the Class of 1978 Scholarship Fund do indeed make an impact! Both of these good students could not have attended the Institute were it not for the financial aid they received through the fund.

Through the tear-offs that come with donations, we learn of news of some classmates. . . . Ken Arbit is now living in Jerusalem, Israel: "Eighteen months ago I started working for a small company in Jerusalem that specializes in data encryption and smart cards. In a few days, Brett Walzer, '77, will be joining the company also. Anyone interested in a tour of Jerusalem is invited to give me a call." . . . Herman Marshall has moved from California back to the 'Tute: "I'm working at MIT in the Center for Space Research with the AXAF Science Center (AXAF is an x-ray astronomy satellite expected to launch in 1998 or 1999 or ...). Fraternity brothers Bob Knecht, Jerry Cole, and Simeon Chow, '77, helped with the move. Child number two is on the way. Our first, Eric, just turned 3."

A. David Stuart sends news from Los Angeles: "I recently joined the ranks of the happily married, and have to say that it's been well



worth the wait. I married Bessie M. Grayson, a southern girl from Arkansas, on September 18, 1993. It was a beautiful garden wedding in Duarte, Calif. (just outside L.A.). I'm still living in Los Angeles and working (fortunately) as a control system engineer at Hughes Space and Communications Co. building communications satellites. A couple of fellow alums work in my group: Greg Procopio, '85, and Vicky Kim Wong, '87.

John Jaynes now lives in Grapevine, Tex.: "We moved into our new house in February 1993. Plenty of room now, but not enough time for all the possible house projects. I was promoted to managing director, marketing planning, at American Airlines in early 1993, then also took over consumer research in August. I spend my spare time with the Navy Reserves, my family, and snow skiing."... Susan Dechant has become partner at the law firm of Bowditch and Dewey in Worcester, Mass. She lives in Stowe, Mass.

Meanwhile, your class secretary and wife Diane Curtis and kids are doing great. Thankfully no one was in our '91 Escort Wagon when it was crushed by a tree last week (but only by 20 minutes or so!). We are busily working our way towards becoming a "van" family, as we were barely fitting in our old car even before it was crushed! Danielle (3) and Luke (2) have been having fun with the test drives. Hannah (6 months) is growing like a weed and appears to be destined for the opera.—Jim Bidigare, secretary, 9095 North Street Rd. NW, Newark, OH 43055-9538, fax: (614) 745-5648, (614) 745-2676

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Henry Perkins is writing network software for Star-Sight Telecast in Fremont. He writes, "We're trying to put TV Guide out of business by dispensing with

paper and putting TV listings on-screen. Also spending much time working on my 1950s house, causing several of my bicycles to gather dust."... Steven Simonoff is in Salem, N. H., at Galactic Industries, which he founded in 1987 to produce chemistryrelated software for spectrometers. Steven is married with a 4-year-old daughter, "who of course is very facile with a mouse and owns a complete collection of Pink Panther movies."... I am sorry to report the death of John Dunlap, who died of the AIDS virus on March 27, 1993, in San Francisco. I was also saddened to notice in a recent Review that Kenneth Rice also passed away last year.—Sharon Lowenheim, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

Congratulations to Alexander Lamis and his wife, violinist Holly Horn; they are expecting their first child in July. (Be sure to send us the details: date, sex, and name.)

Alexander is working as an architect in New

York. Recent projects have included a new

computer-science building at Stanford and

ClassNotes

"Alive and dry in Fort Dodge, Iowa," reports Dr. Marlon Weiss. Marlon lists four children—Noah (6), Molly and Casey (4), and Levi (2) and two dogs—Motley (a border collie mix) and Rubella (a Swiss mountain dog) in the very brief notes I received. Hope to hear more from you, Marlon AND from our fellow classsmates!

Do you realize that it is less than one year to our fifteenth (!!) reunion? I hope many of you are planning on attending. In the meantime write, call, or e-mail and tell us what you have been up to for the last 15 years.

Send your news to: Kim Zaugg, secretary, 549 Fairfield Rd., Canton, MI 48188, (313)981-1785, vayda@erim.org

Late Breaking News: Edward Kinney was promoted to the faculty of the University of Colorado. . . . Robert Wildin joined the faculty of the University of Washington in pediatric genetics in August 1992, where he's "struggling with the bane of academic medicine: getting funding from a bankrupt government." . . . Steven Meltzer was promoted to principal at Scudder, Stevens and Clark, the global investment management firm. His specialty is investment strategy for



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FAX: (617)720-2441 TELEX: 92-1742 EZEKIEL insurance company clients. Steve's also serving as an officer of a mutual fund for Scudder. Travel is a big part of the job, including trips to Miami in July and to Minneapolis in January (brrr!), but Steve still enjoys life in Back Bay and invites visitors who are in town to look him up. . . . Joseph Klevorn finished a finance MBA at Syracuse University, and reports working for the New York Power Authority at the Fitzpatrick nuclear plant.

Philadelphia Story: We learn that R.L. Worthington-Kirsch has been made a partner of MCMC Radiology Associates in Darby, Pa. He practices almost all aspects of diagnostic radiology, subspecializing in angiography and interventional radiography, at Misericordia Hospital in southwest Philadelphia's "knife and gun club." R.L. also reports having a growing practice as a Mohel to the messianic Jewish community. He and wife Kimberly (Wellesley '82) have four children-Caitlyn, 9; Connie, 7; Nyssa, 5; and Thaddeus, 1. Life's been busy, but R.L. does answer his e-mail, and can be reached on the Internet at fractaleer@aol.com.

Finally, congratulations to this year's recipients of the Class of 1981 Student Financial Aid Fund—Joseph H. Karlin and Lisa Thompson. Joseph has completed his undergraduate course work and is anticipating a December 1994 graduation from mechanical engineering's five-year master's program. Eventually he hopes to earn an MBA and get into management consulting. Joseph remains active with Theta Chi and has helped organize a (non-religious) social club for Jewish students. His job last summer was at Lincoln Laboratory, involving research on 3-D methods for making contour measurements of molds.

Lisa is a sophomore in chemistry from Washington, D.C., and hopes to do biomedical research. She plans to attend medical school after graduation, and worked this past summer doing genetic research for the NIH. Lisa is a member of the Black Christian Fellowship and sings in the MIT Gospel Choir. She also tutors local 6th–9th graders with the National Society of Black Engineers. Best wishes to Joseph and Lisa.—Mike Gerardi, secretary, 3372 Olive St., Huntington Park, CA 90255, (310) 553-5050 (w), (213) 587-2929 (h)

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Angela Liao Urdanoff is marketing specialist in high-performance polymers for GE Plastics while not taking care of son, Spenser, born July 1993. Like all proud parents,

she writes, "He's the best thing that ever happened to Steven and me."... Dr. Judith Badner will be finishing her psychiatry residency at McLean Hospital in June and starting an NIMH fellowship in July.

Rita Nothaft-Fordiani is an environmental engineer at CH2M Hill, assisting industry and government with environmental challenges. Mountain climbing during vacations at Mt. Katahdin, Maine, in February and Canadian Rockies in the summer with her husband, Al Fordiani. Al's currently at Harvard getting a master's in teaching and being certified to teach high school biology. He's

doing student teaching and coaching baseball at Lincoln-Sudbury Regional High School.

The recipient of the Class of 1982 Scholarship has been selected. It is Isaac Hands, a sophomore from West Bend, Wisc. He has chosen EE as his major and is very interested in pursuing a career in medicine. He has volunteered at Mass. General Hospital and was involved in a project set up to repair donated medical equipment that will be shipped to lesser-developed countries. Thank you for your contributions and generosity.

Thanks to Philip and Michelle for sending me your notes via e-mail. Philip Greenspun has retired from the cruel world of technology companies ("started five and buried two") to a cozy tenured graduate-student position in EECS at MIT. He's already found Barrie Trinkle and Bennett Leeds, '80, and would like to hear from other East Campus

refugees at philg@mit.edu

Michelle Hunt is currently an assistant professor at the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill (a Money magazine "Best Buy" in college education). She is working on finishing her dissertation on how managers make decisions about which new product ideas to develop. This is her first academic position and she loves it! She writes, "Chapel Hill is a wonderful town and, if I only had time, I'm sure I would really get into all the artistic and other types of entertainment that are abundant here. My husband, Andrick Spicer (Virginia Tech Class of 1991), and I bought a house last June and are settling into the joys (and rigors) of home ownership. He works for a small engineering design company in the Research Triangle that specializes in designing and building electromechanical devices for medical applications." She can be reached at huntm.bsacd1@mhs.unc.edu

As for me, I now work for Hecht and Associates, an educational and consulting company in Sunnyvale, Calif. I am starting up a consulting organization offering services in the areas of business design and leadership. Keep those letters coming!—Helen (Fray) Fanucci, secretary, 502 Valley Forge Way, Campbell, CA; pdalady@AOL.com

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Gardell Gefke is still at the University of Maryland in College Park studying aerospace engineering. Gardell is working as a research fellow in the Space

Systems Lab which moved from MIT to the University of Maryland in 1990. The lab houses a giant swimming pool which is used for neutral buoyancy experiments to model how robotic devices will function in space. Your ever ambitious scribe has actually spent many weekends at this facility which does state-of-the-art robotic work for the space program. MIT made a huge mistake in letting this one get away.

Michele (née Devereaux) Gaudreault received a PhD in aerospace engineering in December 1993 from the Air Force Institute of Technology. Michele will be teaching in the math department at the Air Force Academy during the next school year. She has also

bought a beautiful chalet on five acres, which should provide some running room for her two beautiful daughters, Liana (1) and Marie (4).

Thomas Sherlock writes that he has been working as a developer of the user interface for the Windows version of Mathematica. Thomas has been married since 1988 to Katie. They have a son, Wyatt, who was born in 1991. . . . Roger Spellman writes that he is still at work at Motorola/Codex in Canton, Mass. Roger managed a small group for a while but now he is back to developing and writing software. Roger and his wife, Marcia, had three children by August 1992. In November 1992, their middle child, Jacob, died suddenly while in his crib sleeping. Roger reports that although he is no longer in deep mourning, he is far from recovered from this incident.

Barry Jordan is currently enrolled in the MBA program at the Fuqua School of Business at Duke University. You can reach Barry by phone at (919) 383-7919.... Finally, I am happy to report that I am a director of a public company. The company, Gulf South Medical Supply, went public on March 24, 1994. The price of the stock increased 43 percent on its first day of trading. I am just

happy to be involved.

Please keep those cards and letters coming.—Jonathan Goldstein, secretary, c/o TA Associates, High Street Tower, 125 High St., Suite 2500, Boston, MA 02110

Christopher Kurker completed a PhD in electrical engineering at North Carolina State University in January of 1993. Since then he has been working in mixed-signal IC

design at NCR Microelectronics in Fort Collins, Colo. . . . Jonathan Miller just completed two years at Logitech—the longest job he has ever had except for MIT AV and the most fun. He is scouting the emerging interactive television and entertainment markets for new business opportunities. His company, Diamond Systems, is growing (and expanding!). Jonathan just planned four weekends in a row of skiing and vacation and says life is busy, exciting, and great! . . . Fred Blundell became an assistant professor of mathematics at BU.

Joseph Presing and his wife had their first child, Kristina, who is now 9 months old. He finished his rotation at UTC and is now working at Pratt and Whitney, Middletown, Conn., as a business unit leader. He is not running/jumping a lot of hurdles but has been busy moving into a new home. . . . Suresh Subramanian was married to Uma, an MD, in June 1993. Suresh says they are having a wonderful life in New Jersey. He is still at Bellcore as a director in "Business Process Solutions."

... Jay Fridkis moved to Columbia, Md., and was married in November 1993 to Irene Griff, '87. They met at an MIT N.Y. Alumni/ae Association pub night, but never knew each other at MIT.

Wendy Keilin left the United States in 1989 for some overseas travel in Indonesia and Malaysia and has been living in Australia for the past three years, about to become a dual citizen. She is heading back to the U.S. soon via Western Australia and SE Asia for a visit and for our 10th reunion. (Well, it is already July, but if Wendy could make it where was everyone else at the reunion?) She says she still has the travel bug (an understatement) and is considering a trip to northern Canada and Alaska over the summer while she is in the right hemisphere.

Robert Horowitz left Microsoft in 1992 to start his own business-a newsletter, covering Microsoft's technology and strategic directions, for corporate IS professionals and executives at software vendors, hardware manufacturers, and system integrators. . . . David Martin recently moved from one Washington to the other (West to East), He is still in the Air Force and is assigned to the Pentagon working in the Program Executive Office for Command, Control, and Communications Systems. C3 keeps him busy. . . . Stuart Gitlow wants to know if he is the only one in the class still driving the same car back from his Institute days? Old Fords just last forever.

Deb Summa sent some e-mail to say that she and her husband "had a baby girl on Christmas morning. Her name is Emily Elizabeth TenCate, she's our first child, and she's absolutely gorgeous :) In other news, I've been working out with a Master's swim team and also have been scuba diving with a scientific research and salvage team for about four years (before I got pregnant, of course). Jobwise I've been working in acoustic imaging (sonar, ultrasound, transduction) for about 6 years; I finished a PhD in mechanical engineering about a year ago, after developing one of my projects into a suitable dissertation topic. Last spring my mom and I took a month off and traveled around Eastern Europe and visited some friends and relatives in Italy and Germany. I've been having a good time interviewing prospective MIT students with the Educational Council, and have also gotten involved with the newly formed MIT Club of Austin. In October 1993 I had the great good fortune of being in Boston for a few days and was even lucky enough to see former classmates and mechanical engineering compatriots Andy Mutz (who just moved to the S.F. Bay area to take a job with HP Labs in January 1994) and Beverly Farris Williams (who lives in Boston with her husband and two kids)."-Howard Reubenstein, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213

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(home), hbr@mitre.org

10th Reunion

It's an easy commute on the information superhighway, so this month is Quote-the-

Alumni/ae-Who-Sent-News-by-E-mail

Rob Irion writes in with third person detachment: "Rob has worked for five years as a science writer in the Public Information Office at UC/Santa Cruz. A native of Vermont, Rob particularly enjoys playing beach volleyball in Santa Cruz every week of the year."

Woodrow (Woody) Chin says, "Thank goodness you're on the net—I can't imagine

ClassNotes

sending news otherwise! I'm working for Booz Allen & Hamilton in Arlington, Va., in their Information Technology/Financial Services group. I am working in N.Y.C. on a year-long project, and had a chance to catch up with Richard Mastrangelo. After a few years as director of engineering at Good Housekeeping in Manhattan, where he enjoyed the perk of test-driving a new car almost every week, he has joined Consumers Union, publishers of Consumer Reports. He is the director of power-tools testing (or something like that)."

David I. Bondelevitch also has an interesting career niche: "I have my own company now, dB Sound & Music, and I do music editing and mixing for film and television. I recently finished working with Branford Marsalis on a TV movie of the week called To My Daughter with Love, which aired on NBC. I also teach a graduate level class at USC School of Cinema in Film Sound. I've been keeping pretty busy.". . . Alan Shapiro chimes in: "I will be finishing an MD/PhD program at the University of California/San Francisco in May (1994). The following month I plan to start a residency in pediatrics. I am currently awaiting the results of the match to see where I'm going. Sorry I don't have any research funds to donate, just good wishes.

Mike Cassidy writes "Well, since you make it so easy to send in news!... I hesitate to add news about my small start-up company because it's been such a roller coaster. By the time everyone reads this, all may have changed. But for now, things are going pretty well. We're up to 5 full-time people at Stylus Innovation. (We got started after winning MIT's 10-K \$10,000 award for the Best Entrepreneurial Invention in 1991.) Our software product, Visual Voice, lets you build voice processing applications like Interactive Voice Response (e.g., TouchTone

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Banking, 333-FILM), voicemail, fax-ondemand, and outbound dialing (to remind you of dentist appointments!). We won a BYTE Magazine Best of Comdex Award where we were invited into Microsoft's booth. We're based out of One Kendall Square near the Cambridge Brewery," (Convenient!-Secretary's note.). . . And from Tony Collins: "I work for Xerox where I have been for about four-and-a-half years. My official title is 'Sr. Member of the Programming Staff II': I have no idea what that means. I'm still here in the wildfire, earthquake, mudslide, riot capital of the U.S., Los Angeles. I have been here pretty much since graduating from MIT. I haven't been back to Boston in five or so years and I am actually looking forward to our reunion in '95."... And from Noell Merritt: "Just a quick note from So. Cal. to let you know that Eric Lanzendorf is engaged to Merritt Maduke. They are both getting PhDs at UCSD."

And now a not-so-brief word from Fear-

less Leader, Inge Gedo, Defender of the Faith, Hero of the Realm, Light Unto Nations, and All Around Nice Person: "All is well here in Colorado Springs. I'm not a ski bunny yet, but I'm trying—we've been a few times this season. The house is done and we welcome our friends to visit summer or winter-there's always something to do, especially if you like the outdoors. I also got a trampoline (I mean big, round, 14-footdiameter sucker) for Christmas and it's a blast. Work is fun, but I never knew how much work (time and effort) teachers put into grading. Wow! It's been a fun (almost) year teaching American government and international relations. Meanwhile, this summer Wayne and I are going to enjoy Colorado's white-water rafting and other outdoor activities. In addition I am going to get a chance to escort a group of cadets to the Czech Republic for 10 days. I'll get to use my German again (because I know only a few words of Czech) and I'll get to finally see parts of Eastern Europe that were off limits to us military types for many years. There are a couple of other MIT grads here at the USAF Academy and they've been here a few years already. Captain Larry Butkus is teaching in the engineering mechanics department. Chris Warack is also here-he's teaching in the computer science department and he and his wife, Karen, just had their second child. Chris, my husband, Wayne, and I recently joined Larry in welcoming Cady Coleman ('83) to USAFA for a visit. She's an astronaut with NASA but she's in the newest class and has not yet gone on a mission. I also saw a bunch of MIT people in San Francisco when Wayne and I attended Brett Miwa's ('86, PhD '92) wedding. Brett and Julia, also an MIT grad in biology, treated us to a fun day of rock climbing at a rock-walled gym and a beautiful wedding and reception. They had an onslaught of MIT grads in and at their wedding. Peter Yu was the best man and there were a ton of people from '84-'87. Among the '85ers were George Jaquette, Prisca Chen, Kim Marvin, and Dave Lyons. Peter currently works for the Aerospace Corp., Prisca Chen and Kim Marvin are back in Boston. [Also attending were] Stephanie and Jeff Winner, Mimi Yenari, Jeff Chang, and Megan Smith, '86.All seemed to be doing very wellStephanie and Megan particularly had just been featured in the *New York Times* in an article about women engineers."

Regarding our upcoming reunion, Inge writes, "I'd like to set a new MIT record by getting as close to 100 percent gift/donation participation this reunion year even if people only give the minimum amount to receive Technology Review. If every Class of '85 person gives that minimum amount, not only will we set a participation record, but we will set a record in amount of funds collected. And with some of our class members being so very generous each year anyway some giving thousands of dollars-we'll be in the record books for years to come. I think the Class of 1985 would even win an MIT award at the annual alumni/ae leadership luncheon. Go '85!"

From the snail mail bag: Maciej Zworski is on the fast academic track. A member of the the Mathematics Department at The Johns Hopkins University since 1992, he has been advanced to the rank of professor. Maciej specializes in the study of partial differential equations with an emphasis on scattering theory. He received a PhD from MIT in 1989.

... Karen Phelan and her husband, Tom Hennigan, became the parents of a son, Aiddan, on November 24. Karen is taking a leave of absence from her job as management consultant at Gemini Consulting.... George Jaquette married Julie Sears, SM '90 (Sloan), in September 1991. Living in Seattle, George is telecommuting to California for Silicon Graphics. He loves the e-mail updates on MIT swimming, diving, and waterpolo. (To join the swimnet, send mail to swimnet@mitvma.mit.edu with a request to be put on the listserv mailing list.)

Send news and comments to Bill "I've-notyet-resorted-to- playing-the-lottery-forresearch-funds" Messner, secretary, 5927 Alder St., Pittsburgh, PA, 15232, (412) 361-4180, internet: bmessner@andrew.cmu.edu

Very short on news this month. Jeff Bennett has started his own business and is now president of Bennet-Tec Information Systems. He has eight employees and is

based in St. Petersburg, right outside of Moscow. They are developing Windows software for sale in the U.S. and other countries, with a major focus on the Visual Basic market. They have six products launched, and Jeff writes that it's really been quite an experience. . . . Yong Hahn is currently the chief resident in diagnostic radiology at the University of Chicago. She finished her residency in June and will start an abdominal imaging fellowship at Columbia University in New York City in July. . . . Karen (Wohl) Schmitt made VP at Merrill Lynch. Karen has been spending a lot of time overseas, so much that she and Ray (Schmitt) missed our ski trip because she was in Puerto Rico. Ray is still with IP Morgan.

Erik and I made it out to Colorado for four days of wonderful spring skiing. Jerad was left with Grandma, so we got lots of sleep. Please write!—Mary C. Engebreth, secretary, 21305 Arrowhead Ct., Ashburn, VA 22011, (703) 729-6568

Hope everyone is having a good summer By the time this is published. I should be almost done with my dissertation. Anyone want to take bets on that?? My e-mail

box has been very full this month (hence, no recent plea for news). Good job, and

keep it up.

Nancy Natoli e-mailed from Hellertown. Pa., as she and her family just moved there from Champaign, Ill., so that her husband could take a post-doc at Exxon. Currently working part-time at the Army Environmental Policy Institute, Nancy is using the extra time to care for her daughter, Mary, born in July 1992. She is also redecorating her house, which she bought with mint-green walls and lime-green shag carpet throughout. Nancy saw Chris (Dorn) Kehrley when she was in the United States for a few days over Christmas, She and her husband, Kirk are on the way to Germany for his three-year assignment with the Air Force. Chris recently saw Sue Hughs, who just built a beautiful house in Spokane, Wash. Sue is temporarily stationed in the Saudi desert. While not training for her new role as an Air Force pilot (no longer co-pilot), Sue spends her time reading books, watching lots of movies, and lying out on the beach.

Mark Rapacioli has been working as an engineer for Schein Pharmaceutical for the past four years. His focus lately has been on environmental projects such as hazardouswaste management and regulatory compliance. Mark is searching for some "noshows" to his 10th-year high school reunion, who also happen to be classmates: Glynnis Walton, Walter Dawkins, and Paul Ning: where are you?? Mark's wife, Laura (Ryzowicz) Rapacioli, '89, has just completed her first year at Pace Law School in White Plains, N.Y. They keep busy trying to keep up with their son, Dominick, who is about

Clark Dorman decided that he was making entirely too much money as an aircraft consultant for the U.S. Navv. so he quit, and went back to school, where he is working on a PhD in cognitive and neural systems at Boston University. Now happily poor and living off retirement money, Clark, his wife, RuthAnne, and 2-year-old son, Cambridge (Cam for short), are looking forward to January 1995, at which time Dave plans to graduate and look for a job in the D.C. area.

to enter his "terrible twos."

Avrim Blum, an assistant professor of computer science at Carnegie Mellon University, has won a National Science Foundation Young Investigator Award (NSFYI). Avrim came to CMU in 1991 as a post-doc after receiving a PhD from MIT, and was named an assistant professor the following year. His research focuses on the theoretical analysis of machine learning and on problems of planning from incomplete information. Avrim is now married to classmate Michelle Kirshen, whom he met on his first day as a freshman at MIT. Michelle is a radiology resident at the University of Pittsburgh. They are expecting their first child at the end of April.

Simson Garfinkel reported in after returning from Japan that he is engaged to be married on October 16th of this year to Beth Rosenberg, who is on the editorial staff of

Boston Magazine. Right now, Simson is focusing his energies on finishing his book. UNIX-Haters, which has a publication date of May 11. It is a "self-help book for people in abusive relationships with the UNIX operating system." (Sounds like a book I should read....)

Wendy Cone Gilman reports that she just graduated from RPI with a master's in operations research and statistics. She and her husband, Charles Gilman, who is working to finish a PhD, will be remaining in Troy, N.Y., for the near future. They have spent some time interviewing prospective MIT students as part of the MIT Educational Council, which is how they met Dave Schultz (who did not know either of them at MIT).

Carol Webb Mohr and her husband, Bill Mohr, '84, just had their second child on January 21, 1994. Nicholas Aaron Mohr tipped the scales at 10 pounds, 1 ounce! Carol and Bill are glad to be back in Columbus, Ohio, where they are close to the grandpar-

ent/babysitting pool.

Todd Malone was hired by a small startup company, NUTS Technology, located in Hong Kong. He lives there now, in a small, high-rent flat with his girlfriend from Toronto who was able to join him there. They enjoy dim sum for breakfast, and the nottoo-infrequent junk trips out to the outlying islands for fresh seafood. At NUTS, Todd is working on a video-conferencing board for the PC platform. They plan to remain in Hong Kong for about one more year.

Tom Nichols reports that he is living the "California reality of the '90s": he's not married (not even close), doesn't own a house (not even close), and is not financially independent (not even close)!! Since graduating from MIT, Tom has worked for a couple of defense contractors in California, finally leaving Northrup in 1989 after realizing that there would not be much future in that industry after the fall of the Berlin Wall. He went on to UC/Berkeley where he finished an MBA in May 1992. After that, Tom landed a job at Apple Computer, where he began as project manager for System 7.1, with the product successfully shipped in October 1992. He then became product manager for At Ease, a software-based security product for Macs which are used by more than one person. Tom has overall world-wide responsibility for many aspects of his products, including pricing, forecasting, packaging, and future product development. In his spare time, Tom skis as much as possible, goes to Raiders games, and tries to get into trouble with some of his Theta Delta Chi brethren from MIT, as well as some of his friends from B-School. He says that basically, he is having a blast.

Ace Column Reporter Greer Tan Swiston checks in with more news: First, Stan Oda has become engaged to his girlfriend, Gina, and they will be moving out to San Jose by the end of April so that Stan can start his new job there. Greer's husband, Rob Swiston, is also planning a job change: He leaves FASTech Technologies after working there for four years to join the Boston branch of the Fusion Systems Group of New York City. They are a software consulting firm that deals primarily with financial institutions that are in the process of building automated trading systems. On a recent trip (pre-

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earthquake) to California, they saw Greer's sister Grace, '86, and her husband, Jeff Wang, '86, who are the proud parents of Kelly Yu Wang, born on December 2, 1993. The visit was a great preparation for the Swistons, who by now should have had their own bundle of joy (Rob is rooting for the official due-date of April 1st). Toai Doan and Sofia Merida were both doing well in California when Greer saw them, but had some minor quake damage after that. Toai, living in the Valley, went without power and had to boil his water for a while, and Sofia woke up to a large mess in her apartment. Back home in Boston, they recently saw Steve Holzinger and Rodrigo Merino, who are both currently doing contract work for Fidelity Investments.

Got an update from Coleen (Barry) Smith, who lives with her husband, Doug, '86, on St. Simons Island, Ga. (near Brunswick). Coleen got a master's degree in mathematics education this past August from Georgia Southern University, in affiliation with Armstrong College. As part of her work, she developed a computer system that tracks education resources for grades 7-12 that integrate mathematics, science, and computer technology. She is now wrapping up and documenting the project, and will delay a return to teaching to spend time working on some pet projects: weaving on her loom, and remodeling her family room. Doug is working for Hercules, where he was recently promoted to area supervisor of the Terpene Resins process at the Brunswick plant. Coleen wants to know if she still holds the record for length of round-trip commuting distance (hers was 160 miles).

Julie Marquet is finishing her fourth year of medical school at the University of Virginia, and is currently interviewing all over the country, hoping to get a residency in family medicine. Before starting her residency, she plans to spend three months in Malawi, East Africa, providing health care to refugees in the region. . . . Christopher Reed married Janine Cipriany in 1988. Their daughter, Alyssa Pearl Reed, was born in September 1993. After separating from the Air Force last September, Christopher has been working as a flight instructor while pursuing an MBA at the College of William and Mary. . . . And finally, Mark Foringer is now at the Air Force Institute of Technology at Wright Patterson AFB, where he is pursuing an MS degree in aeronautical engineer-

Thanks for the news!—Jack Leifer, secretary, 2703 Swisher St. #202, Austin, TX 78705, phone: (512) 472-7507, fax: (512) 472-7546, internet: leifer@ccwf.cc.utexas.edu or MIT1987@mitvma.mit.edu

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I am writing this column on the day that Massachusetts broke their 1947 record for the most snow fall in a single winter. Don't worry, the undergraduates did not get

off easy, MIT did not cancel classes during this white winter. Remember the fun we had our sophomore year when MIT closed down for Hurricane Gloria?

Lisa Martin writes that she is engaged to

Greg Bachmann and they are planning a September wedding. Greg, a Cornell graduate, is currently in law school and plans to specialize in patent or construction law. Lisa recently finished an MBA at New York University and is enjoying life without homework. She is very excited about her new position at Moody's Investors Service as a senior credit analyst in their Healthcare Group.

Lisa's letter also included the news of several other classmates. Chris Saito finished with the Navy in December and was admitted into Stanford Business School. After flying missions during the Gulf War, Chris finds sunny California very attractive. . . . Grace Ma is starting a clinical associate position in June with Dr. Steven Rosenberg (he operated on President Reagan) at the National Cancer Institute in Washington, D.C. It is a two-year research and clinical position in surgical oncology.

Jim Casamento was recently engaged to Eva Csizinszky, SM '92, whom he met at Sloan in the Leaders in Manufacturing Program. Jim is a manager at Polaroid. . . . Gloria Hom is now working for G.E. Electrical Distribution & Control in Plainville, Conn. . . . Bruce Pint is an award winner of the Distinguished Postdoctoral Program sponsored by the U.S. Department of Energy's Office of Science and Technical Information. Bruce received a PhD from MIT in ceramics in '92. . . . Elaine Cohen Hubel has been in Raleigh for the last four years and is working hard to finish a PhD.

Nancy Perugini has been promoted to advisory engineer at IBM's T.J. Watson Research Center. Nancy will marry Dave Riggs in early October. . . . Gerald Cohen married Elizabeth Brandwein last August, and they are now living in New York, where Gerald works as an economist at the Federal Reserve Bank.

Ernest Prabhakar has enjoyed traveling around the world for his research in experimental high-energy physics. He was in Hawaii last November on his way to China and visited Scott Beasley and his wife and daughter. In California, Ernest hangs out with many other alumni/ae, including Elizabeth Duxbury, working at JPL and Debbie. Wells, '90, staff researcher who's heading off to grad school in volcano country. Debbie is a geologist, so she was kept pretty busy by all the recent earthquakes! Fortunately, Caltech is very well built, so all Ernest lost was sleep. Ernest hopes to finish up in mid-1995, so he is starting to look for jobs. Given the state of HEP after the death of the SSC, he is strongly considering undergraduate education rather than research.

Have a good summer and if you travel, don't forget to send me a postcard.—Catherine Suriano Singer, secretrary, 131 Main St. #3, Andover, MA 01810 or singer@mit.edu

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There is now an e-mail list of Class of '89 members, so if you are interested in being on the list, please e-mail me at the address below. I will be preprinting this article

over the e-mail list (so people on the list should be receiving copies about 3 months early). Also, by the time this article is published, the Class of '89 will have a World Wide Web site. On-line will be all the class notes, pictures from the reunion, and other class-related information. Any suggestions for additional information will be welcomed! The URL is: http://tns-www.lcs.mit.edu/mit89/

Here is this month's list of people to please write in: Christian Alcala, Zak Aslami, Chris Doerr, Mike Fincke, Mike Quintana, Memo Romero, Martin Serano, and James Veal. What are y'all up to? If anyone knows about any of these people or any-

one else, please write in!

Krisztina Holly's company, Stylus Innovation, has been doing great. Krisztina writes that "last November we released a new software development tool called Visual Voice, which allows your PC to answer or place phone calls, prompt for touch-tone input, speak information from a database, record voice messages... It's really cool! It won a Byte Best of Show award at Comdex last fall and has been selling really well. We've just hired yet another batch of employees... including fellow Bakerite, Alan Gordon, '871"

"Despite long work weeks, I've been doing an okay job squeezing some fun in.... I got completely absorbed in mountain bike racing last fall and am looking forward to the upcoming season," Krisztina continues. Krisztina went skiing with Andy Barrows at Mammoth in December and also went to Jackson Hole in February. "Wow, what a surprise to come back to sunny, 55° weather in February! (You expatriates out West, don't laugh... I'll take what I can get.) As I biked out to Concord yesterday, I ignored the road salt flying in my face and fantasized about summer 'just around the corner.' (...OK, so it's snowing again today!)"

After two years doing research and development for France Telecom, Jacques Demael has been promoted to product line manager and will be chosen next month for the position of director of Marketing and Sales of Datatransmission Products for France Telecom. "Obviously I am bound to live in Paris for quite a while." Jacques writes.

Curtis Eubanks was married last August 8th to Tina Yu in Taiwan. Curtis left Sony in Tokyo after four years in their research labs doing multimedia work, and is now in Monterey, Calif., working for Sony Electronic Publishing Co., writing software for the

General Magic platform.

Dave (Duis) Story writes to say that "life has been great in the last year-I've not only been promoted to 'project leader' at work (my unofficial self-appointed title is 'paperpusher'), but have finally been taking some time to do other activities I had accrued the maximum amount of unused vacation time, so my wife, Christy, and I took off for a week in New Orleans, where there just happened to be two international scuba diving conferences." Dave, who convinced SGI to loan him a \$250,000 Onyx Reality Engine, demonstrated some decompression visualization software, had a booth, spoke in a session on "video imaging," and gave a half-hour virtual reality evening show, New Orleans-style: with a jazz combo doing live improv! "But...I have to say the best part of New Orleans was the eating!"

Dave recently visited L.A. and had lunch with Jin Lim. Jin is employed at JPL, and is busy accumulating vintage Mustangs—he has a '65 California Classic at the moment, and has a plethora of street motorcycles. "I think he lost one nice bike over a cliff last year, but somehow managed not to follow it," Dave writes

Matthew McCarty is still at Grumman Corp. and is currently less than one term away from a master's in MechE at Columbia. . . . Sean Sheeran graduated from the University of Connecticut School of Medicine in May 1993, and is completing an intership in internal medicine through the UConn Internal Medicine Residency Program. Sean will start a residency in diagnostic radiology at Hartford Hospital on July 1.

Dan Canaday will be finishing up med school at the University of Chicago this summer, along with Howard Ro, '90, and Elizabeth Williams, '90. While shopping for residencies in San Francisco, Dan hung out with Randy Duran, '90, Victor Pellicier, '90, Joe George, '90, Mark Siegal, '90, Balaji Gopinath, '88, Paolo Sechi, Yvette Ma, '90,

and Libby Schnieders, '88.

Nat Seshan writes that as he was "glancing through the classes of '86-'92 as usual. looking at the bold print names I found mine. I decided to read to see what I was doing. Apparently not much as I haven't written in." But now, Nat writes that "I finished VI-A at TI-Houston with a master's in December 1989, then I worked here for another six months before taking a swing at a PhD at CMU in September 1990. I loved Pittsburgh. Best city (a little small for me), the best friends, lousy department, especially if you are a TA. I came back here to work for the TI DSP group (the only professional job I've had) in September 1991. I've been here working full-time since. I am half way through an Executive MBA at the Unversity of Houston, which I will finish in June

At TI, Nat is working in Digital Signal Processor architecture. "I can't tell you what I'm doing as I would have to kill you which is hard to do via Internet. But I love my job and Houston's OK. It's been hard working full-time and going to school full-time so I don't get time for a whole lot. I hang out a lot with Mike McMahon, '90, who is in graduate school in bio-electrical engineering at Rice."

Nat wasn't able to make the reunion since he had *Phantom of the Opera* tickets scheduled nine months in advance, which he had to cancel to attend his brother's graduation, also on June 4. "I would ask you to change the date of the reunion (by the way I like the refrigerator magnet, it is still in my office), but perhaps this would be difficult..." (It would be, especially since we printed up all those magnets with the date....) In late June, Nat is going with the EMBA program to take management seminars run by Mercedes and a few other companies. In late July, Nat will be visiting relatives in India.

Jeffrey Pearson is a captain in the U.S. Air Force, "stationed" at the University of Texas at Austin while he pursues an MBA with a concentration in Information Systems Management. "Austin is great—beautiful weather and terrific music," Jeffrey writes.

Roger Horton is halfway through his first

ClassNotes

tour in the Navy, and is the reactor controls assistant on board the USS Los Angeles (SSN-688), which is being overhauled at the Mare Island Naval Shipyard in Vallejo, Calif. Roger is "fortunate to be able to live in the heart of San Francisco, definitely one of the best cities in the world." Roger spent last year racing 35' sailboats in the Bay, and has seen many MIT grads in the Bay area, including many of his Sigma Phi Epsilon brothers.

Well, that's it for this month. If you contributed voluntary class dues, you should be expecting your calendar soon! Thanks!—
Henry Houh, secretary, 4 Ames St., Cambridge, MA 02142; phone: (617) 225-6680, fax: (617) 253-2673, e-mail: hhh@mit.edu or henry_houh@mit.edu; World Wide Web URL: http://tns-www.lcs.mit.edu/mit89/

5th Reunion

Tim Townsend writes that

he is working at Wright Patterson Air Force Base. He's working as a flight simulation development engineer for the Flight Dynamics Directorate of Wright Laboratory. Recently the lab hosted a visit by Professor Sheila Widnall, secretary of the Air Force. This summer, Tim will marry Kathy Dawson in Michigan. Between working and planning for the wedding. Tim has also found time to go skiing in New Mexico with Fred Kennedy and his wife, Vickie. They are both working at the Air Force's Phillips Laboratory in Albuquerque, N. Mex. The Kennedys have just moved into a new home they had built. . . . Also in the Air Force is Aras Suziedelis. He's on a threemonth assignment in Saudi Arabia. Aras reports that snorkeling in the Red Sea is very good and he certainly doesn't miss Boston winters at all! Aras is also busy planning his wedding. He will be marrying Dana Dirmantas of Toronto in a traditional Canadian cer-

After working two years at Texas Instruments (TI) in Houston, Tex., Joe George received a promotion and transfer to San Jose, Calif. Joe specializes in digital signal processors (DSP). He tried to transfer back to the Boston area, but for now he'll have to hang out in California. Before leaving Houston, Joe had a chance to meet Cecil Green, '29, who donated the Green Building at MIT after starting TI. Cecil gives a luncheon in Dallas every summer for MIT students in the VI-A program, and Joe was able to attend the luncheon as a Co-op supervisor. When Joe first moved out to San Jose, he camped out in Los Altos, Calif., at the home of Randy Duran, Victor Pellicier, and Mark Siegel. Eventually, Joe found a place of his own in Los Gatos and realized that he also needed to buy all the necessary northern California accessories-mountain bike, skis, and motorcycle. Joe has also found time to catch up with other alums. He's seen Yvette Ma. Paolo Sechi, '89, Carl Von Ellenreider, Mike

Romero, '88, Libby Schnieders, '88, Sameer Gandhi, '87, and Balaji Gopinath, '87.

C. Hunter Baker is currently working on the PhD portion of the MD/PhD program at Harvard University. He's working in the laboratory of Professor E.J. Corey. . . . Eleanor L. Meyer is also working on a PhD—in chemical engineering at Stanford University. But the really exciting news for Eleanor is that she will be getting married to John DeGroot in April at their hometown of Galveston, Tex.

After working three years as a marketing representative for IBM in Paris, France, Lorenzo Levi is now getting an MBA at the Harvard Business School. . . . Pillan Thirumalaisamy just quit his job at Cambridge Technology Partners in Los Angeles to attend the Anderson School of Management at UCLA. . . . Avisi B. Makatiani just started a multimedia publishing company called Interactive Media Group (IMG) in Boston. They are currently putting a major television show on CD-ROM. Ayisi is also in the process of planning a trip to Kenya with MIT alumns in December. . . . Richard G. McGrath, who received a master's degree from Stanford University in 1991, just completed intermediate flight training. During the training at the Naval Air Station in Kingsville, Tex., students learn to fly the T-2C Buckeye jet trainer.

How is everyone enjoying the summer? Write in about your vacations! Send news to—Ning Peng, secretary, 483 Beacon St., #41, Boston, MA 02115

Jason Slibeck serves as a supply officer on the US\$ Detroit, a combat logistics support ship. He describes the ship as "a 7-11 for the fleet" because it contains extra fuel, cargo, ammunition,

and the like for the other ships in its fleet. The fleet plans a Mediterranean tour. Jason says the Detroit is the next size down from the biggest aircraft carriers. Jason and his wife, Sarah, live in Eatontown, N.J. Jason sends news from other SAEs: Sean Murphy is working on a PhD at Yale in neurophysiology, trying to "figure out how the brain works. Despite Yale's lack of adequate computer resources, Sean is narrowing his thesis topic and enjoys his studies. Henry Dotterer works for Motorola in Chicago, where he is captain of Motorola's hockey team. Henry also found some time to enjoy Mardi Gras in New Orleans in February. Tom Fahy works in programming for Goldman Sachs in New York.

David Oh earned a master's degree from MIT in May 1993, and is now working towards a PhD in aero/astro. . . . Rob Nunez works for Sapient, a software consulting firm in Cambridge. He says that Sapient anticipates significant growth in the next few years and encourages computer science graduates to apply for the new positions there. Rob also reports that John Piscitello works at Mark of the Unicorn Software developing music software.

Ken Nimitz lives about one hour southwest of New Orleans but works offshore in the Gulf of Mexico for Schlumberger. Becky Mattson, Jean Kim, and Jon Fieldman, '93, have all visited Ken in New Orleans, and Ken wrote while he prepared for Mardi



Gras. He and Dylan Cors toured the South on twin Harley Davidson motorcycles last spring en route to a friend's wedding in Alabama. Dylan and Ken also spent a weekend in Chicago last August with their fellow Lambda Chi Alpha pledge brothers Chris Harris, Paul Dans, David Mintz, and Brian Quinn.

Sharra Davidson lives in New York City's Battery Park with her sister. Sharra is enrolled in an acting class that includes New Yorkers from all walks of life. She says that Deep Katdare is also studying acting in New York. Sharra is a consultant for American Management Systems, based in New Jersey, but when I spoke with her in March, she was "on-site" in Manhattan. Janae (Byars) Frasier also works for AMS in New Jersey. Janae's husband, Andrew, is based in Rhode Island with the Navy. Sharra sends volumes of "gossip" about several other classmates: Chris Masalsky and his wife, Amy, recently bought a house in Dedham, Mass. Chris works for the May Institute and is training for regional track meets. Pat Gannon, who is making his much-anticipated "debut" in the Class Notes, works for JP Morgan in New York City, as does Steve Colten. Pat lives with Alex Mayus, who just began a career in banking, and Scott Miller, who works for Price Waterhouse. Paul Kan started as an associate at Donaldson, Lufkin & Ienrette, and is working with derivative products. Sabrina Tellalian is enjoying her first year of both married life and Columbia business school. Cosette Gutierrez is also in her first year of business school at Indiana. Former class secretary Amy Thorsen has continued her involvement in class activities: she is the social chair for her medical school class at NYU. Sharlene Day is also a third year student at NYU medical. Ed Munnich sent Sharra a letter from Japan, where he is teaching English and writing Japanese travel brochures in English. From his experience teaching English and studying Japanese, Ed has noticed a profound generation gap among the Japanese. Ed spent two years teaching in Los Angeles, and compares the two experiences. In Japan, he is "teaching whatever I can sneak past the exam-oriented teachers (though I understand that doing rather than memorizing is the focus of elementary education)." Ed has enjoyed his

experiences abroad, but plans to return in the fall to study language acquisition in a graduate program for either linguistics psychology or cognitive science.

Please keep that news coming! Write to: Andrew Strehle, secretary, 566 Commonwealth Ave., # 406, Boston, MA 02215, (617) 262-3495

My dear classmates, unfortunately I have some very sad news to report this month. I recently received word that our classmate Jina Kim died of leukemia on November 3,

1993. Jina was in school with us through spring 1992 and registered for fall. She would have received her degree in economics that semester. I have been informed that her parents have established a memorial fund in her name to assist a deserving student in his/her quest for education. If anyone would like to contribute to this fund, I'm sure that Jina's family and friends would be honored.

Holly Simpson has recently finished her second year of medical school at Indiana University. Angie Palafox, a first-year student at UT/San Antonio medical school visited Holly in November. Over spring break, Holly visited Alicia Pando in Zurich where she is working. Wow! What a nice trip. Hope it was awesome.

Sonia Chung is teaching high school biology at a private school in New York City, though she did not say which one. She plans, most likely, to do graduate work in education in a couple of years.

That's all the news for now. Thanks to everyone who has written. Keep up the good work; keep writing to me and come visit. The weather is perfect here: 80 degrees, the sunniest, clearest, and bluest sky you've ever seen and no humidity.—Leslie Barnett, secretary, 42575 E. Hwy. 82, Aspen, CO 81611, (303) 920-1988

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Please send news for this column to: Mari Madsen, secretary, 12-16 Ellery St., #405, Cambridge, MA 02138

CourseNews

CIVIL ENGINEERING

John N. Ivan, SM '87, sends word from Mansfield Center, Conn.: "I've recently begun as assistant professor of civil engineering at the University of Connecticut. I am completing a PhD in civil engineering at Northwestern University in the field of transportation. My dissertation is on 'arterial street incident detection using multiple data sources." . . . Willard E. Simpson, Jr., '40, writes: "On the first day of 1986, I retired after 50 years in the civil and structural engineering profession in Central and South Texas. My interest in my company was bought out by a corporation and this year, W.E. Simpson Co. Consulting Engineers is celebrating its 85th anniversary, having been founded by my father in 1909. He was a graduate of MIT in 1905 (deceased 1966). I was his employee from 1946-1966, and company officer from 1966-1986. I'm now working for children, church, and charities (and doing some hunting and fishing)." . . . From New York City, Li-Sze Lee, SM '88, SM '89 (XV), writes: "I am a senior trader at UBS Securities, trading interest-rate options-including caps and floors, swaptions, and various other exotics and structured products." Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

MECHANICAL ENGINEERING

Sadik Kakac, SM '59, SM '60 (XXII), writes from Coral Gables, Fla.: "I am professor and chairman of the Department of Mechanical Engineering at the University of Miami. This past January in Washington, D.C., I received the 1994 Science Award of the Association of Turkish-American Scientists. The award recognizes outstanding scientific work and teaching accomplishments as an educator." . . . Robert R. Moore, SM '83, PhD '86 (V), and his wife, Donna, welcomed baby Richard Robert on March 4th, joining sister, Jill, and brother, Michael." . . . Brent Williams, SM '91, reports: "I passed the Principles and Practices of Engineering Examination and am now a registered professional engineer (PE) in New York State. I work at Xerox Corp. in Rochester, N.Y., on new product development." . . . In January, Peter S. Huber, '73, SM '74, PhD '76, was featured in a New York Times piece by Edmund L. Andrews. Huber, who works as a consultant and part-time journalist, was interviewed about his opinion of the future of telecommunications and the government's involvement. The article begins, "Orwell had it wrong, in Peter Huber's view. In his novel 1984, Orwell predicted that communications and technology would become tools of a new form of totalitarian government. But Huber says these advances have worked against central governments, placing information and processing power in the hands of millions." Huber goes on to talk about the benefits of competing players in the telecommunications field.

The Association of Alumni and Alumnae has been notified that Brigadier General Merlin L. De Guire, SM '40, of Clearwater, Fla, died in June 1984. No further information was provided.

Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

MATERIALS SCIENCE AND ENGINEERING

From Goleta, Calif., McDonald Robinson, ScD '67, sends word: "I am director of Lawrence Semiconductor Research Laboratories in Tempe, Ariz." . . . Hiroshi Menjo, SM '85, reports: "As director at Azca, Inc., a Silicon Valley-based management consulting firm, I am assisting U.S. and Asian companies in developing and implementing their international business development strategies. We specialize in high-tech industries." . . . Carl J. Russo, PhD '78, writes to tell us that he is director of advanced technology and business development at American Superconductor Corp. in Westborough, Mass. . . . Diran Apelian, ScD '73, provost and the Howmet Professor of Engineering at Worcester Polytechnic Institute in Worcester, Mass., has been presented with the 1994 Albert Sauveur Achievement Award by the Philadelphia ASM International chapter. The award is presented annually in recognition of dedicted service to

the society in pioneering materials science and materials engineering achievements and knowledge. "Apelian is known for his pioneering work in various areas of solidification processing, molten metal processing, infiltration of metals, aluminum foundry engineering, plasma distribution, and most recently, spray casting/forming," states a WPI news release....



Marcus W. Shute

Marcus W. Shute, Sr., SM '86, has been selected as the winner of the 1994 Black Engineer of the Year Award for Most Promising Engineer from a field of more than 200. The award recognizes individuals with less than seven years of professional experience who have made tremendous achievements in their

field. Shute was honored for his contributions in the field of fiber optics, his academic achievements, and for serving as a positive role model for students pursuing careers in science and engineering. Shute is expected to earn a PhD in mechanical engineering in June 1994 from the Georgia Institute of Technology after completing his research on polarization-maintaining optical fiber as a sensor of vibrations of thin, cylindrical shells. Shute has been a member of the technical staff at AT&T Bell Labs in Norcross, Ga., since 1986. His responsibilities include the design of the optical fiber used in military applications such as fiber-optic guided vehicles, and the tactical fiber-optic cable assembly used in the Patriot Missile System and Navy shipboard cable; conducting research on specialty fiber measurements such as nuclear radiation-hardened optical fibers and polarization-maintaining optical fibers; and developing the optical-fiber design and development qualification plan for AT&T Network Cable systems for ISO 9000, an international quality standard, registration. In addition, Shute is the CEO and president of his own company, Shute Enterprises, Inc., in Norcross, which is the parent company of Scientific Impact, a technical/engineering consulting firm, and Shute's Custom Car Accessories.

The Minerals, Metals, and Materials Society

DEGREE CODES RF

AE Aeronautical Engineer **Building Engineer** CE Civil Engineer

CHE Chemical Engineer CSE Computer Science Engineer

DPH Doctor of Public Health EAA Aeronautical & Astronautical Engineer

Electrical Engineer EGD Doctor of Engineering ENE **Environmental Engineer**

MAA Master in Architecture Advanced Studies

MAE Materials Engineer MAR Master in Architecture MCP Master in City Planning Mechanical Engineer

ME MET Meteorologist Mineral Engineer MIE

Marine Mechanical Engineer MME MNG Master in Engineering

MPH Master in Public Health

MTE Metallurgical Engineer Naval Architect NA NE Naval Engineer

NUE Nuclear Engineer Ocean Engineer OCE Doctor in Philosophy PhD

ScD Doctor of Science SE Sanitary Engineer Master of Science

has honored two MIT alums. Morris E. Nicholson, Jr., '39 (XIX), ScD '47, professor emeritus of the University of Minnesota, was chosen to receive the 1994 Distinguished Service Award for "more than a decade of volunteer service and leadership in the area of professional registration, including chairmanship of the TMS Professional Registration Committee, development and delivery of the Principles and Practices PE Exam Book II for Metallurgical Engineering to the National Council of Examiners for Engineering and Surveying (NCEES), liaisoning with the Participating Organizations Liaisoning Committee of NCEES, and tireless advocacy of the importance and necessity of registration to all practicing engineering professionals." Nicholson joined Standard Oil Co. as section head of physical metallurgy in 1947, and in 1950, he joined the University of Chicago's Institute for the Study of Metals. He joined the University of Minnesota in 1955 as head of the Metallurgy Department. Since 1970, he has been heavily involved in continuing engineering education, particularly with the National Council of Engineering Examiners." . . . Eugene A. Fitzgerald, '85, member of the technical staff at AT&T Bell Laboratories in Murray Hill, N.I., was selected to receive the 1994 Robert Lansing Hardy Medal Award. This award is presented to an individual under the age of 30 who shows outstanding promise of a successful career in the fields of metallurgy and materials science. Fitzgerald joined the technical staff at AT&T Bell Labs in 1988. His research has concentrated on understanding and improving the quality of mismatched epitaxial materials, and he has produced over 50 papers and holds five patents.

Ronald M. Latanision, Course III professor, has been selected as the 1994 W.R. Whitney Award recipient for his "considerable contributions to a better understanding of corrosion science" by the Houston-based NACE International, a professional technical society dedicated to corrosion prevention and control. The award is named for a past MIT faculty member, Walter R. Whitney, who began the tradition of corrosion research at MIT with The Corrosion of Iron (1903). Latanision, who has written more than 100 scientific papers and presented more than 200 technical lectures, focuses his research in the areas of materials processing and corrosion of metals and other materials in aqueous environments.

The Association of Alumni and Alumnae has been notified that Charles J. Novak, '57, of Allendale, N.J., died on January 21, 1994. No further details were provided. Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

ARCHITECTURE

Walter S. Rask, MAR '85, is living in San Francisco and is the principal architect of the San Jose Redevelopment Agency. We apologize for misidentifying his name and position in the April '94 column. . . . Mindy B. Lehrman Cameron, MAR '82, writes: "An exhibition about garbage management that I designed called 'River of Resources' has been awarded 'best in exhibitions' by *Print* magazine and will be featured in their 'Casebook' in

Autumn '94. The exhibition is in Hartford, Conn. My husband and I recently moved back to San Francisco (actually Mill Valley, Calif.)." . . . Frederick L. Merrill, Ir., SM '80. MCP '80 (XI), reports: "Last February I joined Suburban Campus Properties, Inc., in Woburn, Mass., as VP for acquisitions and development. The company owns and manages multi-family housing and retail developments in the Midwest and Eastern United States." Ellen S. Shoshkes, MAR '77, sends word: "I am director of research of a Ford Foundation-funded study on resident/community-based ownership to preserve at-risk housing, and a PhD candidate in planning and policy at Rutgers, University.' ... Gregory Beck, SM '86, writes: "I recently designed and managed the construction of three state-of-the-art theaters for specialeffects film director Douglas Trumbull (Close Encounters of the Third Kind, Blade Runner, Back to the Future—The Ride). The theaters are the centerpiece of the \$375 million Luxor hotel and entertainment complex, which opened in Las Vegas last October. Titled 'Secrets of the Luxor Pyramid-An Adventure Trilogy,' each environment showcases innovative entertainment technologies that immerse guests in a participatory themed experience. Utilizing motion simulation, 3D film effects, and the world's tallest vertical screen, the theaters transport visitors into a virtual world of adventure and redemption."

John L. Vialet, MCP '64, sends e-mail: "I'm a little startled to realize that this will be the 30th anniversary of my graduation from MIT and the 35th anniversary of my graduation from Harvard College. I will be back in Cambridge for my Harvard Class Reunion, and expect to wander by the Institute as well. I'm still working for the U.S. General Accounting Office (GAO), the 'Watchdog of Congress,' currently studying problems relating to the final days of the Resolution Trust Corp., its merger with the Federal Deposit Insurance Corp., and the expected downsizing of FDIC's asset management and disposition staff. My wife, Joyce, is still an immigration expert at the Library of Congress, and my daughter, Iill (Harvard, '86), is the founder and director of the Museum of Children's Art in Oakland, Calif., which recently celebrated its fifth successful year. I send my best to all my classmates, and particularly Mark Lawner, MCP '63, and John Corrie, MCP '64. I can be reached at <vialet@delphi.com>, via-email ." . . . Marvin J. Richman, '62, has been named the new business dean at Woodbury University in Burbank, Calif. Richman, who lives in Encino, was the president of a number of real estate investment, development, and asset management companies.

The Association of Alumni and Alumnae has been notified that Floyd M. Jennings, MCP '44, of Seattle, Wash., died on September 9, 1992. No further information was provided. Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

CHEMISTRY

Robert E. Kerwin, SM '58, writes: "On February 17, 1994, I was inducted into the New Jersey Inventors Hall of Fame for the

1966 invention of the silicon-gate process for the manufacture of integrated circuits. Silicon-gate transistors are now the single most ubiquitous man-made product, with production levels in excess of 1017 per year. Robert R. Moore, SM '83, PhD '86 (V), and his wife, Donna, welcomed baby Richard Robert on March 4th, joining sister, Jill, and brother, Michael." . . . Walter Stockmayer, '35, PhD '40, Dartmouth College Professor emeritus, had a symposium entitled "Polymer Dynamics and Thermodynamics in Solutions" held to honor his 80th birthday this past April. The event recognized the 1987 National Medal of Science winner's pioneering role in polymer research and was organized by friends, former students, and research collaborators of Stockmeyer's. It was held as part of the 207th American Chemical Society National Meeting. Stockmayer's theoretical and experimental research has dealt mainly with the structures and motions of macromolecules. Various types of such large chain molecules comprise the building blocks of natural and synthetic rubber, plastics, and fibers. At Dartmouth, he served as chair of the Chemistry Department from 1962-66 and from 1973-76. Stockmayer, who officially retired from Dartmouth in 1979, continues through 1994 as an associate editor of the journal Macromolecules. He is also co-author with two Dutch colleagues of a polymer textbook that is expected to be published this fall. .. Fred Ekman, PhD '61, has started Working Papers Co., a Harvard, Mass.-based business that provides business consulting and documentation services. The company will create employee handbooks, regulatory compliance guides, and specialized newsletters for small and mid-sized companies.

Herbert G. Lauterbach, PhD '49, of Wilmington, Del., died on January 25, 1994. He worked at Du Pont Co. for 35 years. He began his career with the company at its Buffalo. N.Y., Research Pioneering Laboratory. Later, he worked in several management and research positions, retiring in 1985 as a research fellow. He was inventor or co-inventor of about 40 patented items, including 501 Nylon. After retiring, Lauterbach was a consultant at Trans-Science, Inc., in Wilmington. He wrote several textile and composite publications, gave oral and written presentations, and was editor of several textile textbooks. . . . The Association of Alumni and Alumnae has been notified that Fred A. Bickford, SM '33, PhD '33, of Painted Post, N.Y., died on December 27, 1991. He had been manager of specialty ceramics at Corning Glass Works, now Corning, Inc.

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ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Murat Azizoglu, PhD '91, writes: "I have been an assistant professor at the George Washington University since the fall of '91. I am busy teaching and doing research in optical networks. Recently, I received an NSF Research Initiation Award to pursue new ideas for future networks." . . . James M. Moran, Jr., SM '65, PhD '68, sends word: "I was awarded the Humboldt Fellowship to do research in astro-

physics at the Max Planck Institute for Extraterrestrial Physics during my sabbatical year from Harvard in Munich." . . . Yalcin Ayasli, SM '70, EE '70, ScD '73, has been named a Fellow of the IEEE for "contributions to the design and development of wideband GaAs monolithic Microwave integrated circuits (MMIC's)." Ayasli has worked as an associate professor in the Electrical Engineering Department at Middle East Technical University, and as a principal engineer at the Raytheon Research Division in Lexington,. Mass. In 1985, he founded Hittite Microwave Corp. in Woburn, Mass., to develop and market microwave integrated circuits for commercial and military sensor and communication applications, where he is currently VP for technology and CEO. He has published technical papers on the design and implementation of wideband microwave amplifiers and signal control components and holds 13 patents. . . . From Patras, Greece, we receive word from George Papadopoulos, SM '64, PhD '70: "I am professor of applied electronics in the Electrical Engineering Department of the University of Patras and have been director of the Applied Electronics Laboratory since 1975. I was head of the department from 1991-93, and am currently director of the Electronics and Computers Division. I'm active in teaching and research—current research interests include microprocessorbased design, microelectronics, embedded controllers, industrial applications, industrial networks, local- and wide-area networks, and telecommunications. I'm a strong participant in European Community programs like Esprit, Race, Stride, and Telematique."



Edward A. Palo

Ed A. Palo, SM '65, has been appointed chief engineer of the Center for Air Force C³ Systems. Palo joined Mitre in 1966 from the Bell Telephone Laboratories. He has held positions of increasing management responsibility and over the years has accumulated a background in radar, communications, and signal-pro-

cessing technology, with special emphasis on microelectronics, coding, electronic warfare, and high-frequency communications.

Woodward Yang, SM '87, PhD '90, assistant professor of electrical engineering and computer science at Harvard's Division of Applied Sciences, is one of three researchers awarded two major grants from Hewlett-Packard Corp. One grant provides seven stateof-the-art workstations for research on file systems, high-performance network interfaces, and custom VLSI hardware for user interfaces. The other grant provides 21 workstations for undergraduate education.

Richard D. Klafter, '58, professor of electrical engineering at Temple University in Philadelphia, has been elected the 1994-95 president of the Robotics and Automation Society of the Institute for Electrical and Electronic Engineers (IEEE). A member of IEEE since 1957, Klafter served as treasurer and VP

CourseNews

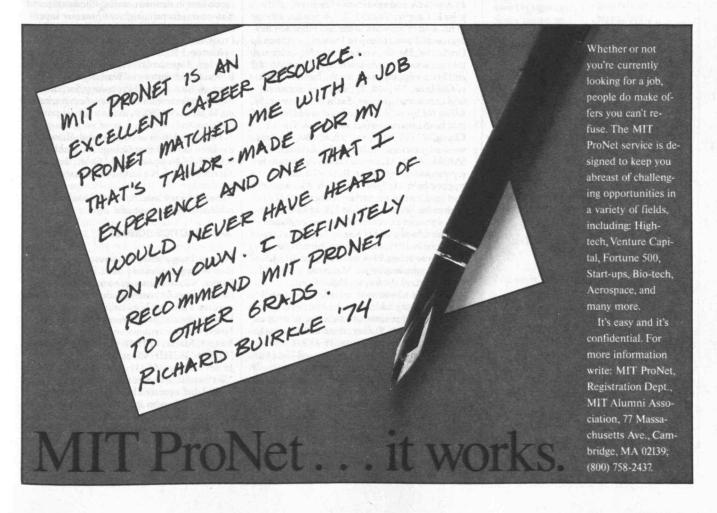
for finance of the society for eight years before being elected president. Prior to joining Temple as a professor in 1984, Klafter taught at Drexel University for 17 years and at the City College of the City University of New York for a year. Klafter's professional experiences includes work with NASA, Ford Instrument Co., Sperry Gyroscope Co., and the American Optical Corp. A consultant for electronic and electrical engineering firms, Klafter also holds two patents, for a heart rate monitor and a touch sensor. His textbook, Robotic Engineering: An Integrated Approach, was published in 1989.

The Association of Alumni and Alumnae has been notified that Alfred M. McClure, SM '31, of Tucker, Ga., died on December 4, 1993. No further information was provided. Alumni/ae may send info for Course News to

mitalum@mitvmc.mit.edu

VI-A INTERNSHIP PROGRAM

As you read this in June, you probably won't be thinking "winter," but as I write this the day following the vernal equinox, I'll be hoping Boston's worst winter in recorded history (over 100" of snow from 19 storms with prolonged sub-zero temperatures) is just thathistory! Now we're contending with deteriorated road conditions and massive potholes as spring emerges.



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Our VI-A company representatives, however, managed to get in and out of Boston between airport closings, attending the annual business meeting followed by an excellent dinner, working their booths at the well-attended Company Open House, and interviewing the 147 students (44.6 percent of VI sophomores) who applied for the program. There are 88 openings for the new VI-A class. My next column will report on the number finally accepting enrollment.

In previous years, when I was closer to VI-A operations, I reported on those VI-A alums who represented their companies for these two intensive days of interviews. This year I'm sure I'd omit someone if I tried. Suffice it to say, it was gratifying to meet so many returning VI-A acquaintances. I felt our warm VI-A camaraderie, established during my 18 years as director, still prevailed and will add to the stability of the program in the future!

Now to our honors and awards notices and then to our VI-A office visitors and contacts. Many of you younger grads will remember Professor Harold Abelson, PhD '73 (XVIII), from 6.001 days. Hal has been awarded the prestigious Class of '22 Professorship starting July 1994. . . . VI-A senior (with Lincoln Laboratory) Igor D. Gonta, has received the Robert Leviton Award from the American Meteorological Society for "his paper describing a calibrated Franklin Chimes to measure

atmospheric potential." Office visitors and contacts since last writing have included: Steven L. Bates, '74, SM '76, EE '76, who was on campus meeting with the Alumni/ae Office to make plans for his class reunion coming in May, and with whom I had an enjoyable and informative luncheon. . . John F. Cooper, '76, SM '76, via e-mail, tells me of his alumni activities in the San Francisco Bay area and of a recent trip to Hawaii. . . . Owen L. Doyle, '84, SM '84, who came by for a visit and told me about his stint teaching in Chad, Africa, and his developing plans for the future. . . . Barry Goldman, '76, SM '77, who was recruiting on campus for Goldman, Sachs & Co., came by, telling me his wife is expecting a third child, and that he maintains contact with Frank T-p Chang, '77 (VI, VIII), SM '79, EE '80, to whom we send greetings. . . . Richard S. Grinnell, '93, SM '93, was at MIT for a Career Fair where he represented his employer, PictureTel, and stopped by to say hello. . . . We had a surprise visit from one of my earliest friends at MIT, Melvin M. Weiner, '55, SM '56, of Mitre Corp., who served as an officer of the former Boston Alumni Chapter of Eta Kappa Nu, when I was president in 1956, and whom I introduced to the current acting VI-A director, Professor J.F. Reintjes, who recollected Mel doing his VI-A

For those of you with e-mail, please note I have added my address to the line below. Much easier for some of you, now, to drop us a note.—John A. Tucker, director (emeritus), VI-A Program, MIT, Room 38-473, Cambridge, MA 02139-4307; phone: (617) 253-4645, fax: (617) 258-7354, e-mail jat@fenchurch.mit.edu

assignments at the former Philco Corp.

James F. Lenney, PhD '47, writes: "I recently reported the discovery of a novel metabolic

pathway for the release of a neurotransmitter (GABA) in the human brain (Brain Research Bulletin 33, 379-85 (1994))." ... Robert L. Sinsheimer, '42, SM '42, PhD '48, has written The Strands of Life: The Science of DNA and the Art of Education (University of California Press, 1994). According to the book jacket, during his 20-year stint at Caltech, "Sinsheimer was involved in the discovery of circular DNA and in the first test-tube synthesis of DNA. He was a major participant in the 'molecular revolution,' which radically transformed the science of life and subsequently provided an understanding of biological processes at their most fundamental genetic level, opening the way to genetic engineering and a biology of synthesis. Writing with simple elegance of his life in science and education, Sinsheimer offers historical and philosophical insights into the development of molecular biology, as well as a view of the daily life of a researcher and administrator." Sinsheimer is chancellor emeritus of the University of California at Santa Cruz, and a professor in the Department of Biological Sciences at the University of California at Santa Barbara. Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

John M. Andrews, PhD '64, writes: "I have founded Nantron Associates, an electronic service company based in Alexandria, Va., that specializes in nanostructures, silicon chip and wafer manufacture, high-temperature superconducting, and advanced battery technology. I took early retirement from AT&T Bell Labs in Murray Hill, N.J., in December 1989, after 23 years. I spent two years with the Naval Research Laboratory in Washington, D.C., as head of the Advanced Processing Section of the Nanoelectronics Processing Section, resigning in January 1992 to assume my current position."

The Association of Alumni and Alumnae has been notified that George W. Mahlman. ScD '48, of Newport Beach, Calif., died on March 7, 1994. No further information was provided.

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X-A PRACTICE SCHOOL

Four years ago when I was researching and then writing the history of SCEP, Arthur I. Power, '42, was among the most eloquent of many alumni/ae correspondents. Now he's at it again. From his Boulder, Colo., office where he is a chemical process/project consultant, Power writes a reminiscence of six weeks in Bangor, Maine, in 1941 with Roy P. Whitney, '35, SM '37, ScD '45, as station director and James McNitt, SM '41, as assistant director. "We lived in a boarding house at 4 First Street owned and operated by a Mrs. Dillingham, a very nice lady who fed us well and provided rudimentary but comfortable quarters. The daily trek to the Eastern Corp. plant in South Brewer was an adventure in itself, with six of us crammed into a four-door sedan operating on war-time gas and tire rationing. The class of three undergraduates and three graduate

students was a diverse collection of personalities, but the Practice School mystique was somehow a leveler. We had an absolutely great human experience along with learning the rudiments of production chemical engineering and (perhaps) leaving a modest mark on the operations of the Eastern plant. (This latter is a hypothesis; we never got any real feedback.) . . . The daily human contacts were perhaps most memorable; for example, those matter-of-fact, laconic Down-Easters pulling shredded paper out of that awesome Fourdrinier machine; the grizzled operator measuring the flow in a pipeline by putting his ear to it; the confident, comfortable managers who were always willing to give us neophytes a little time; the operator who grabbed me by the necktie and cut it off as I approached too close to the Fourdrinier. This was memorably stimulating learning through interaction with a broad variety of plant people, and we learned in the best way a lesson for the future: how important this kind of interaction was (and is) in keeping a plant running."

G(eorge) Harry Kemker, SM '81, has been advanced to a principal in Towers Perrin, an international management consulting firm; he's based in Chicago. He joined Towers Perrin in 1988. . . . From Burbank, Calif., Mosum E. Tsui, SM '82, reports that he's an investment manager in the Treasury Department of the Walt Disney Co. . . . Harold A. Richards, Jr., SM '41, and his wife, Eleanor, celebrated their 50th wedding anniversary on Christmas Day 1993, with guests including classmate Joseph Finger, SM '41. "We're still traveling," writes Richards-"last year to Wimbledon, then a month in Scotland. Financial activities, golf, and various clubs have us over-organized in our 13th year of retirement from Exxon."

Carol Phillips in the SCEP office reports that Reza Mehrabi, SM '90, ScD '94, successfully defended his doctoral thesis early last spring and continued his research almost without taking a breath as a post-doc with Professor Robert A. Brown. . . . Carol also reports a long telephone visit with Mona Lou, '92, SM '93, reporting on herself and five classmates. Lou is working for Du Pont in Wilmington as a process engineer in fluorochemicals research—looking for alternatives to Freon. Peter Ronco, '92, SM '93, is in New Jersey (location unspecified) doing modelling and simulation for Unilever. Rachel M. Thornton, '92, SM '93, is with Merck in West Point, Pa. Now married (no details), Trinidad Flores, '92 (X, XVIII), SM '93, is with Arco-Alaska. Jennifer Chan, '92, SM '93, now a home-owner in Louisiana (location not given), works at Exxon Chemicals. And Michelle Toyofuku, '92, SM '93, formerly an environmental scientist with Unitek Environmental Consultants, Honolulu, has abandoned Hawaii and at the time of Ms. Lou's report was job-hunting in New Jersey.

Julian T. Baldwin, SM '24, died in West Chester, Pa., on January 10, 1992; he was a long-time resident of West Chester and employee of Armstrong Cork Co., Lancaster, Pa... After finishing his doctorate in SCEP, John E. Eberhardt, ScD '36, went to work at Bethlehem Steel Corp.; 35 years later he retired from the company's research management staff and moved to Plantation Estates, Matthews, N.C., where Eberhardt died on March 1, 1994. ... Also reported early last spring was the death in Hendersonville, N.C.,

on September 26, 1993, of Karl F. Cast, SM '41, who retired in 1982 as VP of Ethyl Corp., Baton Rouge, La. Mr. and Mrs. Cast moved to North Carolina following retirement. . . . The Association of Alumni and Alumnae has also been informed of the death on June 2, 1992, of Max S. Salomon, SM '22, in Margate, Natal, South Africa; further information was not available.—John Mattill, *Technology Review*, MIT, Room W59-200, Cambridge, MA 02139. Or send news to Carol Phillips at SCEP, Room 66-309, MIT (617) 253-6600 or e-mail <Carol@pracshool.mit.edu>.

URBAN STUDIES AND PLANNING

Lydia Kowalski, MCP '73, writes: "I'm now working at UCLA as administrative officer for the School of Engineering. I'm enjoying learning about all the new experiments. In the past five years, since I moved to Los Angeles, I've survived riots, fires, floods, and the big earthquake. Also went to China and twice to Hong Kong-once for a trial! I'm also divorced, but I'm finally managing to resurrect 'joie de vivre." . . . Patsy M. Doherty, MCP '86, reports: "I work for Lotus Development Corp. as the Lotus Notes beta administrator in charge of their worldwide testing program for Notes core product." . . . Wilhelmus J.A.M. Overmeer, PhD '89, sends word: "I will be a visiting professor from August '93 to August '95 at the Stern School of Business at New York University." . . . Juan Antonio Brando-Pradilla, '83, writes from Bogota, Colombia: "I became president of Urbana Architects/Planners, a design office established in Bogota. It specializes in urban and architectural design, but offers integrated services ranging from urban design to interior design, including architectural and landscaping design as well."

Frederick L. Merrill, Jr., SM '80 (IV), MCP '80, reports: "Last February I joined Suburban Campus Properties, Inc., in Woburn, Mass., as VP for acquisitions and development. The company owns and manages multi-family housing and retail developments in the Midwest and Eastern United States." . . . Laurence E. Susskind, MCP '70, PhD '73, Course XI professor and director of the MIT-Harvard Public Disputes Program at Harvard Law School, has recently come out with Environmental Diplomacy: Negotiating More Effective Global Agreements (Oxford University Press, 1994). According to the book jacket, Susskind "examines the weaknesses of the existing environmental treaty-making system and the increasingly important role of nongovernmental interests in environmental diplomacy. [He] offers new approaches to designing 'nearly self-enforcing' agreements that can ensure compliance without threatening sovereignty and maintains that more effective institutional arrangements are within reach." Alumni/ae may send info for Course News to mitalum@mitvmc.mit.edu

EARTH, ATMOSPHERIC AND PLANETARY SCIENCES

Commander David M. Schubert, SM '90, writes: "I am currently working at the Pen-

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tagon on the Joint Staff, and will be leaving in September '94 to command a submarine." . . . Robert A. Gilcrest, '51, reports: "I am retired going on 19 years. I'm into gardening and giving lectures on global warming and ozone depletion."

William B. Jones, SM '91, sends word: "I am currently pursuing a master of divinity degree from Andover Newton Theological School, working toward ordination in the United Church of Christ as a minister-in-training at Plymouth Church in Framingham. I also serve as religion and ecology coordinator for faith and science exchange at the Boston Theological Institute."

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OCEAN ENGINEERING

A. Paul Amesse, SM '67, NE '67, sends word: "I am director of business development at PDI Corp. in Annapolis, Md. However, I run the marketing operations from my office in Crystal City, Va. I am the current secretary of the MIT Club of Washington."

George A. Uberti, SM '54, reports: "I retired from NASSCO in 1989. I received the SNAME Distinguished Service Award in

1993."

Modeling Engineering Systems: PC-Based Techniques and Design Tools (High-Text Publications, 1994), is a new book by Jack M. Lewis, SM '66, NE '66. It is a step-by-step guide to building and solving math models that outlines all the fundamental tools needed to model and analyze any engineering system—electrical, mechanical, fluid, or thermal. Lewis is VP of Scientific Marine Services, Inc., in Escondido, Calif. He specializes in the design of automatic control and instrumentation systems, especially as related to the marine industry.

Rear Admiral Charles Norville Payne, SM '48, USN (ret.), of Annapolis, Md., died on February 9, 1993. No further information was

provided.

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XXV ECONOMICS

B. Peter Pashigian, PhD '60, writes: "My new intermediate microeconomics text *Price, Theory, and Applications*, was published by McGraw-Hill in January '94. The textbook combines theory with many applications that emphasize consumer and producer behavior in private markets. Besides core chapters, chapters on such topics as cost of time, the governance of the firm, free rider problems, and asymmetric information are included. My current research is on why the seasonal in retail automobile prices has disappeared over time. I have served as co-editor of the *Journal of Business* at the Graduate School of Business of the University of Chicago during the last six years."

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XV MANAGEMENT

Frank E. Gillett, SM '92 (XVII), SM '93, writes: "I started work at Symmetrix, a change services management consulting company in October '93. I can be reached via email <frangi@symmetrix.com>." . . . John O. Barnett, SM '91, reports: "I married Sheila Ryan, MD, in August 1993." . . . Judy G. Young, SM '82, sends word: "I became an owner of a McDonald's franchise in 1992." . . . Lawrence B. Kilham, SM '66, writes: "We have moved from New Jersey to my birthplace, Santa Fe, N.M, where I am doing consulting to high tech companies and running my new venture in air-quality instruments, Eco Sensors." . . . M. Cory Zwerling, SM '85, reports: "I married Andrea Boston (from Melbourne, Australia) on July 10, 1993, in New York City. We're living in the glamorous state of New Jersey! I am working for Bristol-Myers Squibb as a director for managed health care in the ever-changing pharmaceutical industry." . . . From New York City, Gautam M. Advani, '73, writes: "After 19 years at Shearson, I left there in early summer 1992. Since mid-summer '92, I have been at Republic New York Corp., helping in putting together their securities firm, Republic N.Y. Securities Corp." . . . Darryl K. Mikami, SM '86, sends word: "Corinne and I announce the birth of our third child, Kaleb Matthew, born on December 21, 1993. At least siblings, Kyle and Kendra, are getting their normal night's rest." . . . William A. Gillett, SM '85, reports: "I'm currently VP for business development for Cross/Z International, a database software developer specializing in marketing decision support systems built on fractal geometry-based data structures. I live and work in New York City."

Christopher Thieme, SM '88, writes: "I am an assistant VP at Citibank's Asia Pacific Division office in Singapore. I arrange financings supported by the export credit agencies of OECD countries for both sovereign and private borrowers in developing countries." . . From New York City, Li-Sze Lee, SM '88 (I), SM '89, writes: "I am a senior trader at UBS Securities, trading interest rate optionsincluding caps and floors, swaptions, and various other exotics and structured products." . . . David C. Dubbin, '80 (VII), SM '85, reports: "We just celebrated our son Greg's 7th birthday. Our daughter, Karen, will be 5 later this year. Susan has returned to her banking career after spending some time at home with the kids. My job as manufacturing strategic planning manager for Motorola keeps me busy-I had seven inter-

national trips last year!"

Philip N. Duff, SM '84, has been named CFO at Morgan Stanley Group, Inc., in New York City. He had been a principal at Morgan Stanley and Co. . . . Judith C. Lewent, SM '72, has been named a director at Quaker Oats Co. in Chicago. Lewent continues as senior VP and CFO at Merck & Co., Inc., in White House Station, N.I.

John R. Talbot, SM '62, of Westfield, N.J., died on February 1, 1994. Talbot was VP of W.R. Grace & Co. in New York City, before retiring 23 years ago. He was a Navy veteran of the Korean War.... The Association of Alumni and Alumnae has been notified that Louis L. Banks, of Naples, Fla., died in 1993. Banks was a Sloan School professor from 1983–86. No further information was provided.

SLOAN FELLOWS



Darryl K. Williams 1965, and has held

Darryl K. Williams, SM '90, has been named VP and managing director of regional support services (Asia Pacific) and president of Eastman Chemical Japan Limited, by Eastern Chemical Co. Williams joined Eastman at its headquarters in Kingsport, Tenn., in 1965, and has held various positions in

the company including a stint as director of business planning and photographic products at the Eastman Kodak Co.

From Santa Monica, Calif., Norman C. Peterson, SM '63, who retired from TRW in 1985, writes: "I am president of our community security operation, with 960 member households. We hire four patrol cars to keep us safe. Very effective. All association administrators are volunteers." . . . Gerhard H. Schulmeyer, SM '74, is now at Siemens Nixdorf in Munich, Germany. He was president and CEO at ABB/America, ABB Asea Brown Boveri, in Stamford, Conn.

John A. Blanchard, SM '78, is executive VP for corporate development activities at General Instrument Corp. in Chicago. He was chair and CEO at Harbridge Merchant Services in Downers Grove, Ill. . . . Michael P. Morely, SM '87, is senior VP and director of human resources at Eastman Kodak Co. Previously, he was VP and general manager of the Rochester, N.Y.-based company. . . . J. Phillip Samper, SM '73, has been named president of Sun Microsystems Computer Corp. He is the former vice-chair of Eastman Kodak Co. and a venture capitalist. . . .

The Association of Alumni and Alumnae has been notified that **Donald C. Watters**, SM '67, of Johns Island, S.C., died on February 2, 1993. No further information was provided.

SENIOR EXECUTIVES

Owen C. Zidar, '84, of Bloomfield, Mich., died on April 24, 1993. He retired in 1991 as the stamping and assembly engineering manager for all Ford manufacturing plants. Zidar began his career with Ford in 1957 as a labor representative, then worked his way up the managerial ladder with posts in St. Louis, Los Angeles, and Kansas City. He served in the U.S. Army from 1954-56. Among other associations too numerous to mention, Zidar was director of Christian Brothers Institute of Michigan, on the board of directors of Brother Rice High School, and vice-chair of the steering committee of Boy Scouts of America in 1978.... The Association of Alumni and Alumnae has been notified of the following deaths: Albert S. Trube, '60, of Houston, on

January 29, 1989; Robert Booth, '60, of Tacoma, Wash., on August 8, 1993; and Daniel J. Harnett, '68, of Los Angeles, on November 2, 1992. No further information was provided. Alumnilae may send info for Course News to mitalum@mitymc.mit.edu

MANAGEMENT OF TECHNOLOGY

Taro Hattori, SM '89, reported that the MOT Convocation Party that he and Yoshiaki Takahashi, SM '89, organized and held in Japan on May 21, 1993, will become an annual event. Minoru Nomura, SM '89, acted as chair of the convocation and 17 MOTs attended the enjoyable event. . . . Audie Hittle, SM '91, asked us to pass along a reminder that if you are visiting the greater-Boston area, call him ahead of time and he will arrange a Sloan MOT-mini reunion as he was able to organize for Takahiro Oikawa, SM '91. Give Audie a call or send e-mail <hittlea@v3.hanscom.af.mil>. . . . Alex Karpovsky, SM '91, recently visited the MOT office. He is actively involved with his software consulting company, Karpovsky & Associate Software Co., here in Cambridge. ... Naoki Kato, SM '91, has recently changed positions. He is now the group leader of the Patent and Licensing International Affairs Group at NTT R&D Information and Patent Group, managing overseas patent applications and technological contracts involving foreign countries. . . . Takahiro Oikawa, SM '91, of the Yazaki Corp. attended the March 1994 ICRMOT meeting. Upon arrival, he had dinner with a group of MOTs that included Kari-

na and Audie Hittle, SM '91, Peter Dunbeck, SM '79 (XVI), SM '91, Anne and Tom Heller, SM '91, Soo and Roger Glovsky, SM '91, Barney Ussher, SM '92, Larry Smith, SM '93, and Yoshio Noda, G, '94, a Yazaki student. While in Boston, Takahiro met with Ioe Pine, SM '91, who was at MIT presenting his work on his new book, Mass Customization. Takahiro also had a working lunch with Audie that continued at the MOT study center to discuss technology transfer and cooperative R&D.... Andries Botha, SM '92, Richard Bailey, SM '93, and Andries' new manager, Gideon de Wet, director of policy studies at CSIR, visited with MOT program co-chair, Professor Ed Roberts, '57 (VI), SM '58 (VI), SM '60, PhD '62 (XIV), and MOT director Rochelle Weichman in February. They were on their way to a conference in Miami. Andries is enjoying his new position as corporate technology manager at CSIR since October 1993. . . . Both Richard and Andries report their families are well. All had dinner with Ben van Vliet, G, SM '94, and Carl Pistorius, G, SM '94, and their families on February 23, 1994. . . . Jim Brown, SM '92, of Daimler Benz will be relocating from Stuttgart, Germany, to Alabama to support their new Mercedes Benz plant in April 1994. ... Joe Fitzgerald, SM '92, has a new title as RISC microprocessor chief technologist. Joe is now responsible for investment strategy of power PC. According to Joe, Bruce Dewar, SM '92, deserves our best wishes and congratulations on an upcoming wedding! . . Armando Izquierdo, SM '83 (II), SM '92, has started a special two- to three-year assign-

CourseNews

ment at PDVSA in strategic planning coordination. Armando is working on a technology management project regarding practices corporation-wide. He began the project over one year ago with Pugh-Roberts, and will return to Inteven in one or two years. . . . Vandana Upadhyay, SM '92, wrote to inform us she is now working with Sam Pitroda at MTI International in Menomanee Falls, Wisc. Pitroda's article entitled "Development, Democracy, and the Village Telephone," was published in the November/December 1993 issue of the Harvard Business Review. Evidently, he incorporated Vandana's perspective into the article. . . . Ionathan Green, '77 (VIII), SM '93, and Jennifer Stone are thrilled to announce the arrival of Elise Lascoe Green and Eric Page Green on December 6, 1993. Congratulations! . . . Steven Wu, SM '93, is currently working on an electric vehicles project. Steven visited 17 companies in the United States during January of 1993. Due to inclement weather, Steven was stranded at Logan Airport and had an opportunity to update us on his latest research. . . . The MIT Management of Technology Program Class of 1995 traveled to London, England, for the management field trip. The trip, January 22-29, began with a reception at the Hyde Park Hotel, including more than 50 local MIT and Sloan alumni/ae. Among the 10 organiza-

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Rochelle Weichman and Bruce Bond

tional visits during the trip, the MOT participants visited British Telecom on January 24, hosted by Bruce Bond, SM '83. On behalf of Sloan Executive Education, MOT program director Rochelle Weichman presented a gift to Bruce for his generous hosting of this MOT and previous PSE visits to British Telecom .-MOT Program, MIT, Room E56-290, Cambridge, MA 02139.

AERONAUTICS AND ASTRONAUTICS

Stan Rosen, SM '70, sends word from Los Angeles: "I was recently assigned as manager of strategic planning for Hughes Aircraft Co. (GM Huges Electronics) Defense Systems. I'm completing a three-year term as a member of the National Space Society board of directors and I'm also serving on the NSIA Space Committee board of directors." . . . James A. Blissit, Jr., SM '86, reports: "I am working to keep the F-22 advance tactical fighter program on track." . . . Ken Amer, SM '47 sends email: "After writing a thesis on helicopters, I worked for six years at NACA Langley doing helicopter flight research. In 1953, I joined Hughes Helicopters in Los Angeles and there I worked for 33 years, my last job as manager of technology during the development of the Apache helicopter, which was so successful in Desert Storm. In 1987, I retired from Hughes and joined the Rand Corp. as a part-time resident consultant. I have participated in helicopter studies, including a risk analysis of the U.S. Army's LHX helicopter program (now the Comanche helicopter), a study of helicopter crashworthiness, and a study of helicopter-to-air combat. I have written more than 40 technical papers, the latest a paper on helicopter crashworthiness that I will present to the forthcoming Forum of the American Helicopter Society. My wife, Hedie, and I recently celebrated our 70th birthdays with a party of 65 of our friends and relatives.'

George F. Unger III, SM '69, of Washington, D.C., died on August 11, 1992, of complications associated with the treatment of HIV infection. He worked in Washington, D.C., at the Naval Air Systems Command for 12 years before joining NASA in 1980. At NASA, he was responsible for the research program that successfully led to quieter helicopter designs. . . . The Association of Alumni and Alumnae has been notified that Alan H.

Yates, SM '46, of Centerport, N.Y., died on November 6, 1993. No further information was provided.

Alumni/ae may send info for Course News to mitalum@mitvmc.mit.edu

POLITICAL SCIENCE

Frank E. Gillett, SM '92, SM '93 (XV), writes: "I started work at Symmetrix, a change services management consulting company in October '93. I can be reached via e-mail <fran-

gi@symmetrix.com>.'

A new book by Eugene B. Skolnikoff, '49 (VI), SM '50 (VI), PhD '65, Course XVII professor, is The Elusive Transformation: Science, Technology, and the Evolution of International Politics (Princeton University Press, 1993). According to the book jacket, "From the global reach of television to the danger of global warming, from the green revolution to the massive deployment of nuclear weapons, advances in science and technology have become the most powerful and persistent forces leading to societal change. This is the first comprehensive attempt to show how changes in science and technology affect the world political system-and are affected by it." ... Regional Advantage: Culture and Competition in Silicon Valley and Route 128 (Harvard

University Press, 1994), is a new book by AnnaLee Saxenian, PhD '89. The book has created quite a stir on both coasts as it pits Silicon Valley against Route 128 and brands the latter the loser. The University of California at Berkeley professor asserts that Silicon Valley's "flexible way of doing business" enabled it to overtake its East Coast cousin as the nation's

center of technological innovation.



Jesse L. White, Jr.

On February 24, 1994, Jesse L. White, Ir., PhD '79, was sworn in as Federal co-chair of the Appalachian Regional Commission (ARC). He was appointed by President Clinton and confirmed by the U.S. Senate last February. The ARC is a federal-state partnership created under the Johnson

administration to promote economic development in the Appalachian counties of 13 states. The federal co-chair and 13 ARC governors comprise the council, and a governor serves as the state co-chair for a one-year term. The federal co-chair represents the president and the federal interests in the commission. The ARC administers an annual budget of about \$180 million devoted to building highways, enhancing education, funding infrastructure, promoting health, building the business base, and promoting a regional cooperation. For four years prior to his appointment, White was a consultant, lecturerer, and writer in the fields of economic development, public policy, and strategic planning. His major project during 1992-93, was to serve as the secretary and managing consultant to the 1992 Commission on the Future of the South. From 1982-90, he

served as executive director of the Southern Growth Policies Board, an economic think tank serving the 14 governors of the southern states and located in Research Triangle Park, N.C. White served as the chief policy planner for higher education in the U.S. Department of Education during the Carter administration.

Albert Teich, '64 (VIII), PhD '69, and Mark S. Frankel are co-editors of The Genetic Frontier: Ethics, Law, and Policy (American Association for the Advancement of Science, 1994). The book is a collection of 15 essays that look at the implications of the Human Genome Project, begun in 1990 at a cost of \$3 billion. Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

Robert R. Reitano, PhD '76, writes: "I was promoted to second VP at the John Hancock in March 1994. I manage the Investment Policy and Research Department." . . . Jerrold Grossman, PhD '74, a professor in the Oakland University Mathematical Sciences Department, is the 1993-94 recipient of the Award for Distinguished College or University Teaching of Mathematics. The award is given by the Michigan Section of the Mathematical Association of America. Grossman, on staff of Oakland since 1974, has written a textbook in discrete mathematics, two manuals for students and instructors, and numerous articles. His previous honors include OU Teacher of the Year, an Outstanding Teacher Award from the Michigan Association of Governing Boards, and an OU Alumni Association Award for Outstanding Academic Advising.

Charles G. Lange, PhD '68, died on June 25, 1993. Lange was with the University of California at Los Angeles and a member of the the American Mathematical Society for 45 years. No further information was provided. . . The Association of Alumni and Alumnae has been notified that Grant H. Strong, '50, of Richland, Va., died on June 22, 1992. No further information was provided. Alumni/ae may send info for Course News to mitalum@mitvmc.mit.edu

BIOLOGICAL SCIENCES

From Holtwood, Pa., Harmon L. Liebman, SM '54, writes: "During the past year, I've had the good fortune to have traveled to the Mideast and Africa as well as within the U.S. on matters of industrial interest. Some of this was as a paid consultant, some just to help out a bit in the area of food dehydration and freeze-drying. Hopefully, we'll see some of the food technology group in Atlanta during July '94." . . . Laura Green, PhD '81, reports: "I am president and senior scientist of the consulting firm, Cambridge Environmental, Inc. The company specializes in toxicology and risk assessment, environmental modeling, and scientific problem-solving. I am always happy to hear from other scientists and engineers interested in consulting.' Alumnilae may send info for Course News to mitalum@mitvmc.mit.edu

NUCLEAR ENGINEERING

From Rome, Italy, Arnaldo Turricchia, SM '62, writes: "I am head of the nuclear systems group at ENEL SpA Construction Department. I design work on containment systems for advanced nuclear power plants." . . . Sadik Kakac, SM '59 (II), SM '60, writes from Coral Gables, Fla.: "I am professor and chairman of the Department of Mechanical Engineering at the University of Miami. Last January I received the 1994 Science Award of the Association of Turkish-American Scientists. The award recognizes outstanding scientific work and teaching accomplishments as an educator." . . . Frederick W. Buckman, PhD '70, was named president and CEO of PacifiCorp of Portland, Ore. He was president and CEO of Consumer Power Co. in Jackson, Mich.

Xiu-Bing Wei, SM '87, of Malden, Mass., died on December 7, 1993. She was an ear, eye, and nose specialist, and plastic surgeon, as well as a laser medicine researcher at MIT. She won several awards for her research on the clinical applications of lasers on oral-facial cancer. She was a founding fellow of the American Society for Laser Medicine and Surgery and a member of the executive board of the International Society for Laser Medicine and Surgery. Wei was an active member of the Boston Chinese community She also advised the Massachusetts Office of International Trade and Investment.

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TECHNOLOGY AND POLICY PROGRAM

Eric Pallais, SM '83, is the construction manager for GTM on half of one of the largest bridges in the world, the new Severn Crossing. He and his wife, Natalie, are expecting their third child this summer. . . . Richard Davies, SM '84, has been working for British Rail on its privatization program and he has just returned from a mission to the Czech Republic. . . . Philippe Jolly, SM '85, and Sabine Abravanel got married on March 5. 1994. Best wishes from everyone at TPP! . . . Kevin Fitzgerald, SM '86, is in his last year of a doctorate in demand-side management of electric power and would appreciate any job offers. . . . Henry Elkington, SM '88, a consultant from the Boston Consulting Group in telecommunications, is married to Sabina and had a daughter last summer. . . . Simon Stokes, SM '88, was married in September to Sarah "Buzz" Burrows, and continues European law as a solicitor for McKenna and Co. in London. . . . Seab Adamson, SM '91, is an environment and energy consultant for London Economics, and has just returned from a three-week mission to China. . . . Nick Mabey, SM '93, has obtained a post as research fellow at the London Business School doing research into the economics of global climate change. At the same time, he is studying for a PhD in environmental economics at University College in London.—Richard de Neufville, TPP, MIT, Room E40-252, Cambridge, MA 02139

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Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

William H. Vogt, '19; November 25, 1993; Rochester, N.Y.

Max S. Salomon, '22; June 2, 1992; Margate, Natal, South Africa

George W. Jones, '24; February 1, 1994; Leesburg, Fla.

Julian T. Baldwin, SM '24; January 10, 1992; West Chester, Pa.

Arthur G. Hall, '25; November 19, 1993;

Wauwatosa, Wisc. Andrew George Olsen, '25; January 1, 1994;

Daytona Beach, Fla.

Bruno E. Roetheli, '25, SM '27; December 26, 1993; Wellsboro, Pa.

Charles Kingsley, Jr., '27, SM '32; February 20, 1994; Pittsburgh, Pa.

Clara F. Smyth, MPH '27; December 19, 1993; Falmouth, Mass.

Raymond P. Delano, Jr., '29; November 11, 1993; North East, Md.

Laurence L. Waite, '29; December 26, 1992; Arcadia, Calif.

Carlton E. Wood, '29; February 5, 1994; San-

ta Maria, Calif. Lloyd T. Goldsmith, SM '29; August 14,

1993; Sherman Oaks, Calif. Ellis Edlow, '31; November 13, 1993; Pom-

pano Beach, Fla.

Howard P. Emerson, '31; February 15, 1994; Zachary, La.

Alfred M. McClure, SM '31; December 4, 1993; Tucker, Ga.

James R. Merrill, '33; January 26, 1994; Santa Barbara, Calif.

Barbara, Calif. Fred A. Bickford, SM '33, PhD '33; December

27, 1991; Painted Post, N.Y. Robert J. Stoddard, SM '33; December 4,

1990; Inver Grove Hts., Minn. Graydon L. Abbott, '34; January 14, 1994;

San Jose, Calif.

Raymond P. Holland, Jr., '34; November 29, 1993; Roswell, N.M.

James H. Kimberly, '34; January 29, 1994; West Palm Beach, Fla.

Ruth MacFarland, '34; February 21, 1994; Stafford Springs, Conn.

Dillard Jacobs, SM '34; October 28, 1988; Nashville, Tenn.

Baldwin Anciaux, '35; January 29, 1994; Seattle, Wash.

Edward H. Taubman, '35; January 22, 1994; Baltimore, Md.

Karl P. Goodwin, '37; February 24, 1994;

Needham, Mass.

Irwin G. Freydberg, '38; December 16, 1993; Chappaqua, N.Y.

George B. Wood, '38 December 26, 1993; San Diego, Calif.

Humbert P. Pacini, '39; February 7, 1994;

New Hartford, N.Y. John H. Bech, Sr., '40; February 18, 1994;

Wilton, Conn. John J. Casey, '40; February 15, 1994; Port

Washington, N.Y.
Merlin L. De Guire, SM '40: June 1984:

Merlin L. De Guire, SM '40; June 1984; Clearwater, Fla.

Luis G. Jimenez Michelena, '41; December 14, 1993; Madrid, Spain

Alan E. Surosky, '41; January 7, 1994; Winter Springs, Fla.

Karl F. Cast, SM '41; September 26, 1993;

Hendersonville, N.C.

Milton Kaplow, '42; September 2, 1989;

White Plains, N.Y.

Duncan M. Wilson, '42; November 1993; Potsdam, N.Y.

Newton I. Steers, Jr., '43; February 11, 1993; Bethesda, Md.
Robert P. Dodds, '44: December 21, 1993;

Encinitas, Calif. Floyd M. Jennings. MCP '44: September 9.

Floyd M. Jennings, MCP '44; September 9, 1992; Seattle, Wash.

Geno DiBagno, '45; November 22, 1990; Greensburg, Pa.

Richard J. Howard, Jr., '45; January 30, 1994; Buffalo, N.Y.

James V. Chabot, '46, SM '65; December 27, 1993; Blacksburg, Va.

Alan H. Yates, SM '46; November 6, 1993; Centerport, N.Y.

James S. McCoy, '47; July 30, 1993; Detroit, Mich.

Charles Norville Payne, SM '48; February 9, 1993; Annapolis, Md.

David R. Israel, '49, SM '51; February 15, 1994; Alexandria, Va.

Herbert G. Lauterbach, PhD '49; January 25, 1994; Wilmington, Del.

Grant H. Strong, '50; June 22, 1992; Richland, Wash.

Peter C. Darin, Jr., '51, SM '60; February 7, 1994; Seneca, S.C.

Edmund R. Renier, '51, SM '52; February 6, 1994; Lake Forest, Ill.

Albert H. Rooks, '51; December 22, 1993; Seattle Wash.

Alfred A. Wolf, Jr., '53; January 22, 1994; North Truro, Mass.

Charles R. Sandlin, NE '53; January 12, 1994 James J. Arnold, '54; October 5, 1993; Tulsa, Okla. Frank J. Leeds, '54; July 26, 1991; Milton, Mass. Gerard De Saussure, PhD '54; October 29, 1991; Oak Ridge, Tenn.

Satyaki Basu, SM '55, ScD '60; June 5, 1985; Calcutta, India

Svein Hovind, '56; July 15, 1993; Oslo, Norway Charles J. Novak, '57; January 21, 1994; Allendale, N.J.

Mary R. Rocchio, '57, SM '65; January 7, 1994; Sherborn, Mass.

David M. Ross, '58; 1994; Miami, Fla. Robert Booth, '60; August 8, 1993; Tacoma, Wash. Albert S. Trube, '60: January 29, 1989; Hous-

Albert S. Trube, '60; January 29, 1989; Houston, Tex.

John R. Talbot, SM '62; February 1, 1994; Westfield, N.J.

William G. Kay, Jr., SM '63; February 5, 1994; South Dartmouth, Mass.

Finis Morgan, '64; October 20, 1993; Alexander City, Ala.

Stephen L. Snover, '65; February 11, 1994 Donald C. Watters, SM '67; February 2, 1993; Johns Island, S.C.

Daniel J. Harnett, '68; November 2, 1992; Los Angeles, Calif.

Rolf Steendal, SM '68; December 7, 1993;

Wrentham, Mass. Charles G. Lange, PhD '68; June 25, 1993;

Los Angeles, Calif. John F. White, PhD '73; January 13, 1994; Summit, N.J.

Thomas F. Vasak, '74; 1993

John C. Dunlap, '79; March 27, 1993; Fort Lauderdale, Fla.

Owen C. Zidar, '84; April 24, 1993; Bloomfield Hills, Mich.

Xiu-Bing Wei, SM '87; December 7, 1993; Malden, Mass.

t has been a year since I reviewed the criteria used to select solutions for publication. Let me do so now. As responses to problems arrive, they are simply put together in neat piles, with no regard to their date of arrival or postmark. When it is time for me to write the column in which solutions are to appear, I first weed out erroneous and illegible responses. For difficult problems, this may be enough; the most publishable solution becomes obvious. Usually, however, many responses still remain. I next try to select a solution that supplies an appropriate amount of detail and that includes a minimal number of characters that are hard to set in type. A particularly elegant solution is, of course, preferred, as are contributions from correspondents whose solutions have not previously appeared. I also favor solutions that are neatly written, typed, or sent via e-mail, since these produce fewer typesetting errors.

Problems

JUL 1. Jorgen Harmse is greedy. He wants South to make a bid of 1NT redoubled with 6 overtricks (for the highest possible declare score) against best defense after a reasonable auction. Your editor is not a Bridge guru, but when I become omnipotent you will get more points for bidding and making 7NT redoubled than for bidding 1NT redoubled and making 7.

JUL 2. Nob Yoshigahara wants you to find three positive integers. 1) The smallest integer having the property that the first 10 digits of its square root are unique. 2) The smallest integer whose square consists of 10 digits all unique. 3) The smallest integer having the property that the first 10 digits of its reciprocal are unique.

JUL 3. Timothy Malony is not at all afraid of sunburns. Just before a business



SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

PuzzleCorner

trip to Manila (14 degrees N latitude) around the end of April, he calculated that the sun should be directly overhead around noon, and indeed it was. For a spherical earth in a circular orbit around the sun with the earth's axis tilted at 23 degrees with respect to its orbital plane, find an exact trigonometric expression to give the latitude at which the sun is directly overhead (around noon) as a function of time of year.

Speed Department

Hillary Fisher wants to know how many times a year does Earth revolve.

Solutions

F/M 1. We begin with a bridge problem that Jerry Grossman reports arose in a Sarnia, Ontario, sectional pairs game.

The contract is an ambitious 7 NT. West leads the 2 of clubs. How do you bring home the contract?

George Blondin managed to squeeze this one into his schedule; indeed, in some cases, he did it twice

Since the heart finesse works, declarer has 12 easy tricks. Another trick must come from heart jack, spade 10 or small club. This is done with a 3 suit squeeze on East at trick 9 followed, if needed, by a 2 suit squeeze on West at trick 11.

First nine tricks are club K, spade ace, club ace, all the diamonds.

If East discards a heart, heart king falls to ace setting up heart jack.

If East discards a spade, spade 10 is made on a finesse.

If East discards a club, South discards heart jack. Now, when the heart queen and ace are lead, West must discard from S J x or C J.

Club discard sets up South's 3. With spade discard, a lead to spade king drops queen and jack, setting up spade 10 for last trick.

F/M 2. The late Robert High played a game in which two opponents took turns rolling a die. The loser is the first one not to improve on the other player's last roll. What is the probability that the first player will win?

A slick solution from Kenneth Bernstein who realized that to solve the problem you need only solve the problem, which you can do by solving the problem

Let P(n) be the probability that the player whose turn it is will win when the current roll to beat is n. This must be equal to the probability that this player will roll m (with m>n) and that the other player will not win. Thus:

$$P(n) = \sum_{m=n+1}^{6} (1 / 6)(1 - P(m))$$

This recursion relation is easily solved: $P(m) = 1-(5/6)^{6-m}$. A the beginning of the game n=0. Thus the desired probability is $1-(5/6)^6$.

If the regular die is replaced with an unbiased k-sided die, the above procedure leads to the probability $1-([k-1]/k)^k$. This expression is relatively insensitive to k, varying from a high of 0.75 (for k=2) to a low of $1-1/e\approx0.63$ (for $k=\infty$).

F/M 3. Dudley Church recommends the following problem from *The Puzzling Adventures of Dr. Ecco*, written by my NYU colleague, Dennis Shasha.

There are 13 logicians in a room, all wearing jackets. On the front of each logician is a name tag and all the logicians have different names. On the back of some of the jackets is a big X. Each of the logicians can see the back of everyone else's jacket, but not his own. Initially, someone comes into the room and says, 'At least one of you has an X on his back.' The problem is for each logician to figure out whether he has an X or not.

They do this in the course of several rounds. In each round, the logicians who have not yet decided whether they have an X on their backs speak in alphabetical order. Each logician either says:

I don't know whether I have an X on my back, or I don't have an X on my back, or I do have an X on my back and at least one other logician does also but has not yet said that he does or I do have an X on my back and all other logicians who do have already said so.

They are not allowed to say anything else.

As soon as a logician decides, that is, announces, that he does or doesn't have an X on his back, he stops speaking. This is what happens. In the first round, four people decide. In the second round, three people decide. One decider in the second

round says there are more Xs. In the third round, the remaining six decide.

The following lucid solution is from Ira Gershkoff.

I assume the question is how many Xs were there at the start of the game, and how did each come to the conclusion that he did or did not have an X on his back.

If there were only one X, that person would see no other Xs. He would be able to decide immediately, and announce that there are no other Xs. Everyone else would decide in turn, and the game would require two rounds at most.

If there were only two Xs, the first of them to speak would not be able to decide, but the second one would know he had an X, because he would see only one X, and would realize that if he did not have an X on his back, the first logician with an X would have been able to decide. Once the second X logician decides, each remaining logician in that round knows that the decider is the last X to speak that round, since if there were more, he would not have been able to decide. Therefore each of the remaining logicians does not have an X and can so announce. In the second round, the remaining Xer sees no more Xs and knows that he has the remaining X, but everyone else must now wait for the remaining Xer to decide and announce whether there are more Xs or not. (With only two Xs there are no others, but the other logicians don't know this.) Those logicians who must speak before the remaining Xer cannot decide until the Xer decides. This game might take three rounds but does not meet the requirement that one of the second round deciders states there are more Xs.

If there are three Xs, the last logician with an X to speak would see that the other two were not able to decide, and that there are no more Xs in view. He would therefore know that he had an X, and so announce. The remaining logicians in the first round would then decide that they do not have Xs. The second and subsequent rounds would play like the two-X scenario above.

If there are four or more Xs the game must go at least four rounds, which does not fit the data of the problem. Therefore there must be three Xs, and the X logicians are the 1st, 7th, and 10th speakers. The last Xer to decide must be the first speaker, or else the game will go four rounds.

Other Responders

Responses have also been received from R. Bishop, F. Carbin, J. Chandler, T. Curtis, S. Feldman, M. Fountain, C. Gabor, I. Gershkoff, J. Grossman, J. Harmse, W. Hartford, R. Hess, R. Holt, D. Lang, C. Larson, G. Marks, S. McCartney, D. McMahon, R. Moeser, L. Nissim, P. Rauch, J. Rich, K.L. Rosato, G. Roskes, J. Rudy, I. Shalom, L. Steffens, A. Tayor, D. Van Patter, D. Wachsman, K. Wise, and K. Woods.

Proposer's Solution to Speed Problem

366 (367 in leap years) on its axis (definition 1), relative to the stars, plus once around the sun (definition 2), or 367 (368) plus a fraction.

MIT LIFE INCOME FUNDS

MRS. HOLLAND H. HOUSTON

HOME: Lacey, Washington

CAREER: Born in Spokane, Mrs. Houston met her husband, Holland, a 1924 graduate of Course 6A, when he was travelling as an electrical engineer with the Federal Power Commission and she was secretary to the director of the Washington State Public Service Commission. They married in 1940 and settled in Seattle, where Mr. Houston served as president of the MIT Club of Puget Sound. In 1948, the governor appointed Mr. Houston state power commissioner, a position he held during the turbulent struggles among California, Oregon, Washington, Idaho, Montana, public and private power companies and others over water rights to the Columbia River and rights to the power generated by the Bonneville Power Authority and the Grand Coulee Dam. When the governor's term of office ended, Mr. and Mrs. Houston retired to their farm overlooking a bay on Puget Sound. Mr. Houston died in 1972.

LIFE INCOME FUNDS: Frances A. Houston Gift Annuities, to be added to the Holland H. (1924) and Frances A. Houston Fund.

QUOTE: We have no close relatives, and since Holland had so loved MIT and I loved my associations with it, I had no thought but to make MIT the sole beneficiary of my will. I only recently realized that I could make a gift to MIT and retain enough income to live in the retirement community I am enjoying now. When I asked MIT for help in setting up the gift, Mr. Darden responded with MIT precision and with thoughtful kindness. I now have several gift annuities and peace of mind.

For more information about gifts of capital, write or call D. Hugh Darden, W. Kevin Larkin or Frank H. McGrory at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.



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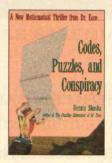
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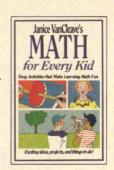
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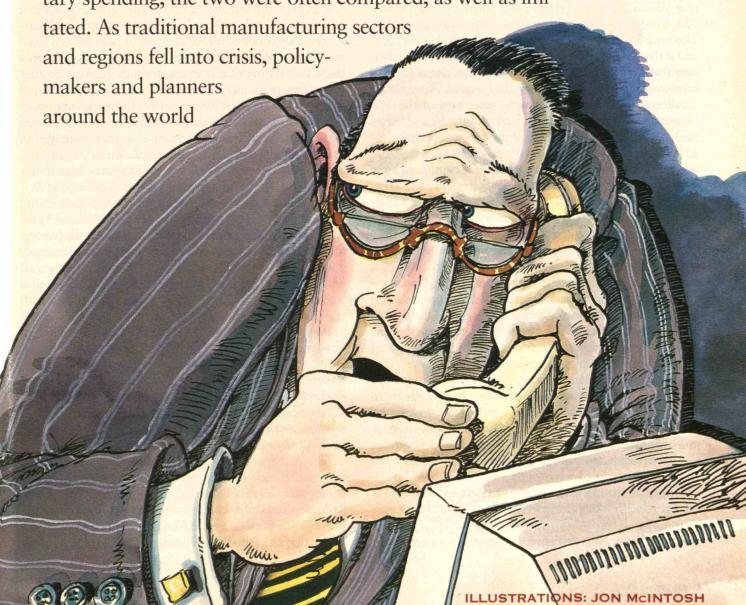
Lessons firon

ORTHERN CALIFORNIA'S HIGH-TECH DISTRICT HAS

LEFT BOSTON'S ROUTE 128 IN THE DUST, PROVING THAT A REGION'S INDUSTRIAL STRENGTH DEPENDS ON MORE THAN JUST THE PROXIMITY OF ITS FIRMS.



uring the 1970s, northern California's Silicon Valley and Boston's Route 128 attracted international acclaim as the world's leading centers of innovation in electronics. Both were celebrated for their technological vitality, entrepreneurship, and extraordinary economic growth. With common origins in university-based research and postwar military spending, the two were often compared, as well as imitated. As traditional manufacturing sectors



looked to these fast-growing regions as models of industrial revitalization, seeking to replicate their success by building science parks, funding new enterprises, and promoting links between industry and universities.

This enchantment waned during the early 1980s, as the leading producers in both regions experienced crises of their own. Silicon Valley chipmakers relinquished the market for semiconductor memory to Japanese competitors, while Route 128 minicomputer companies watched customers shift to workstations and personal computers. Both regions faced the worst downturns in their histories, and analysts predicted that they would follow the path of Detroit and Pittsburgh to long-term decline. It appeared that America's high-technology industry, once seen as invulnerable, might not survive the challenge of intensified international competition.

But the performance of these two regional economies soon diverged. In Silicon Valley, a new generation of semiconductor and computer firms emerged alongside established companies. The dramatic success of start-ups such as Sun Microsystems, Conner Peripherals, and Cypress Semiconductor, as well as the renewed dynamism of large companies such as Hewlett-Packard and Intel, were evidence that Silicon Valley had regained its former vitality. Route 128, in contrast, showed few signs of reversing its decline. The once-hailed "Massachusetts miracle" ended abruptly, and start-ups failed to compensate for continuing layoffs at established minicomputer companies such as Digital Equipment Corp., Data General, Prime, and Wang.

Silicon Valley is now home to one-third of the 100 largest technology companies created in the United States since 1965. The market value of these firms increased by \$25 billion between 1986 and 1990, dwarfing the \$1 billion increase of their Route 128 counterparts. Although the two regions employed workforces of roughly the same size in 1975, Silicon Valley firms generated some 150,000 net new technology-related jobs over the next 15 yearstriple the number created along Route 128. In 1990, Silicon Valley producers exported electronics products worth more than \$11 billion, almost one-third of the nation's total, compared with Route 128's \$4.6 billion. That same year, Silicon Valley was home to 39 of the nation's 100 fastest-growing electronics corporations, while Route 128 claimed only 4. As the '90s began, both southern California and Texas had surpassed Route 128 as locations of fast-growing electronics companies.

Why has Silicon Valley adapted successfully to changes in international competition while Route 128 appears to have lost its competitive edge? Despite similar origins and products, these two regions evolved fundamentally distinct industrial systems after World War II. Their dissimilar responses to the crises of the 1980s reveals differences that

ANNALEE SAXENIAN is an assistant professor in the Department of City and Regional Planning at the University of California at Berkeley. She is the author of Regional Advantage: Culture and Competition in Silicon Valley and Route 128 (© President and Fellows of Harvard College, Harvard University Press, 1994), from which this article is adapted.

had once been seen simply as superficial disparities between "laid back" California and the more "buttoned up" East Coast. Far from being superficial, the contrast between the two regions spells the difference between success and failure in an era of rapid technological change.

COLLECTIVE INNOVATION

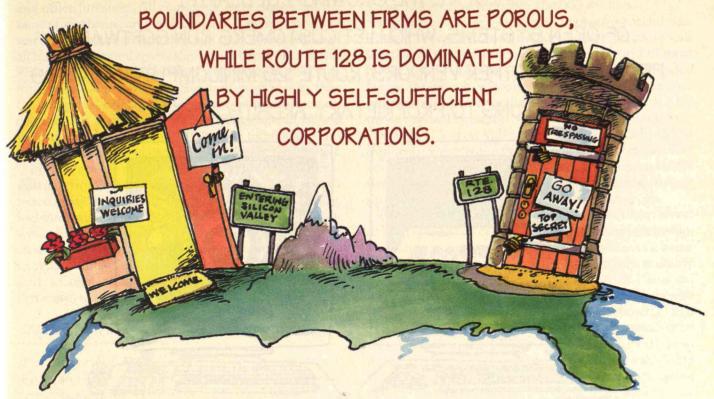
Silicon Valley has a decentralized industrial system that is organized around regional networks. Like firms in Japan and parts of Germany and Italy, Silicon Valley companies tend to draw on local knowledge and relationships to create new markets, products, and applications. These specialist firms compete intensely while at the same time learning from one another about changing markets and technologies. The region's dense social networks and open labor markets encourage experimentation and entrepreneurship. The boundaries within firms are porous, as are those between firms themselves and between firms and local institutions such as trade associations and universities.

Northern California's regional networks owe their existence largely to the region's status as a latecomer to electronics manufacturing. In the 1940s and 1950s, researchers at MIT and Stanford University, as leading beneficiaries of defense and aerospace contracts, spear-headed the economic transformation of both eastern Massachusetts and northern California. But the Boston area had a rich history of industrialization that gave it an edge in competing for government contracts. By World War II Massachusetts was home to many electronics manufacturers, while Santa Clara County and its environs remained an agricultural region. Aside from a handful of small electrical firms such as Hewlett-Packard, Varian Associates, and Litton Engineering Laboratories, the only local industry was small-scale food processing and distribution.

Silicon Valley's pioneers sought to replicate Boston's technology complex but unwittingly transformed it in the process. Unhampered by industrial traditions, the region's founders created a distinctive technological community.

While MIT's leadership focused on building relations with government agencies and seeking financial support from established electronics producers, Stanford's leaders—lacking corporate or government ties and proximity to Washington—promoted the formation of new technology enterprises and forums for cooperation with local industry. In the 1950s, for example, Stanford opened its classrooms to local companies through the Honors Cooperative Program. The university encouraged engineers at electronics firms to enroll in graduate courses directly or through a televised instructional network that brought Stanford courses into company classrooms. This program strengthened ties between firms and the university and helped engineers keep up to date and build professional contacts. The school also sponsored Stanford Industrial Park, one of the first such developments in the country. By 1961 the park covered 652 acres and housed 25 companies that employed 11,000 people.

IN SILICON VALLEY,



After three decades, the Santa Clara Valley—or Silicon Valley, as it came to be known—had transformed itself into a dynamic technology complex specializing in the manufacture of semiconductors. By 1975 the region's technology enterprises employed well over 100,000 workers, and its agglomeration of engineers, electronics firms, specialist consultants, venture capitalists, and supplier infrastructure was paralleled only by that of its East Coast counterpart.

While building a new center of electronics manufacturing, Silicon Valley's pioneers created an industrial system more flexible than that of Massachusetts, one organized around the region and its professional and technical networks rather than around the individual firm. None of Silicon Valley's founders had roots in northern California; a surprising number had grown up in small towns in the Midwest and shared a distrust for established East Coast institutions and attitudes. Virtually all were young white males trained as engineers. Having left behind families, friends, and established communities, they were unusually open to risktaking and experimentation.

The experience of working at Fairchild Semiconductor Corp.—which spawned many of the region's start-ups—served as a powerful bond for many of the early semiconductor engineers. The socializing that grew out of these quasi-familial relationships supported the ubiquitous practice of collaboration and information-sharing among local producers. Social contacts also functioned as efficient job-search networks. In fact, engineers switched firms so often that mobility not only was socially acceptable but became the norm. In the words of one engineer, "Two or three years is about max [at a job] for the Valley because there's

always something more interesting across the street."

Not surprisingly, Silicon Valley's engineers developed stronger commitments to one another and to the cause of advancing technology than to individual companies or industries. According to a semiconductor executive who has worked in the region for three decades: "Here in Silicon Valley there's far greater loyalty to one's craft than to one's company. A company is just a vehicle that allows you to work. If you're a circuit designer, it's most important for you to do excellent work. If you can't in one firm, you'll move on to another one."

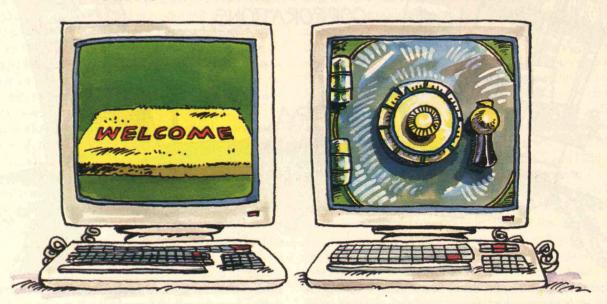
The region's culture encouraged risk taking and accepted failure. In contrast to eastern venture capitalists, who typically were financial professionals, Silicon Valley's venture capitalists were often entrepreneurs who had made money by creating and then selling technology firms. These backers became unusually involved with their ventures, advising entrepreneurs on business plans and strategies, helping find co-investors, recruiting key managers, and serving on boards of directors.

Silicon Valley's decentralized industrial system was held together in part by a variety of informal and formal cooperative practices and institutions. Many of these practices were simply attempts to be neighborly. One executive recalls that in the early days of the semiconductor industry it was not uncommon for production engineers to call their friends at nearby competing firms for help when quartz tubes broke or they ran out of chemicals.

In other cases, cooperation was a carefully calculated business decision. Semiconductor firms formed joint ventures and liberally cross-licensed their patents to competitors during

DESPITE THE GROWING POPULARITY

OF OPEN SYSTEMS, WHICH LET CUSTOMERS RUN SOFTWARE PRODUCED BY OTHER VENDORS, ROUTE 128 MINICOMPUTER MAKERS CLUNG TO PROPRIETARY ARCHITECTURES.



the industry's first three decades, ensuring that technical advances diffused quickly and the industry as a whole progressed, regardless of the fate of any individual firm.

Business associations played a key integrative role in Silicon Valley's decentralized industrial system as well. The Santa Clara County Manufacturing Group worked with county government to solve environmental, landuse, and transportation problems. The Western Electronics Manufacturers Association (forerunner of the American Electronics Association) sponsored management seminars and other educational activities that provided useful information and fostered collaboration among small and medium-sized companies. And the Semiconductor Equipment and Materials Institute worked hard to build consensus around technical standards for semiconductor wafers. By 1975, more than 80 percent of all new wafers met the institute's specifications. Many Silicon Valley engineers reported that the process of standard setting was as important as the standards themselves, because it helped build close understandings and working relationships between suppliers and end-users.

THE HP WAY

In an environment that lacked indigenous industrial traditions and experienced managers, Silicon Valley's pioneers explicitly sought to avoid the hierarchical structures of East Coast companies. Long before it was fashionable, William Hewlett and David Packard—Stanford graduates who founded instrument maker Hewlett-Packard in 1937—and later Intel's Robert Noyce pioneered management styles based on teamwork and participation. Even as their firms grew large, they strove to preserve the openness, intensity, and sense of purpose that had characterized working life in early Silicon Valley start-ups. This management style, characterized by a high degree of professional autonomy and generous employee benefits, came to be known as the HP Way.

Hewlett and Packard themselves played a central role in creating this corporate culture. They remained deeply involved in the day-to-day operations of their company. They made a point of striking up informal lunch and hall-way conversations with employees at all levels, and they encouraged managers to "wander around," spending part of each day initiating unplanned discussions.

In place of the centralization that characterized the traditional hierarchical American corporation, HP created a corporate office that provided strategic vision and shared administrative infrastructure for a decentralized organization. Hewlett and Packard established product divisions as semi-autonomous business units, with full responsibility for product development, engineering, manufacturing, marketing, and personnel. When one of these quasi-independent businesses grew too big, it would be broken down into smaller units. This structure not only increased the organization's responsiveness but also greatly reduced the decision-making authority of senior management.

A hallmark of the HP way was the elimination of most traditional corporate status symbols, including private

offices, reserved parking spaces, and differentiated attire and office furniture. All employees were eligible for the same profit sharing and stock options. The company sponsored a first-rate cafeteria that was open to employees of all ranks, intramural sports teams, and Friday beer blasts. While many of these innovations were symbolic, they contributed to a culture that was far more participatory than the traditional low-trust management of most American corporations at that time. And the culture spread far and wide: during the 1960s and 1970s, most technology firms in Silicon Valley assimilated various aspects of the HP Way.

Ironically, while the region's engineers saw themselves as different from the rest of American business, they failed to recognize the connection between the institutions they had built and their commercial success. They saw themselves as a new breed of technological pioneers, and viewed their successes as independent of the region and its relationships. This lack of self-understanding would lead to choices that would threaten the long-term dynamism of the industrial region they had created.

YANKEE INDIVIDUALISM

While Silicon Valley producers of the 1970s were embedded in, and inseparable from, intricate social and technical networks, the Route 128 region came to be dominated by asmall number of highly self-sufficient corporations. Consonant with New England's two-century-old manufacturing tradition. Route 128 firms sought to preserve their independence by internalizing a wide range of activities. As a result, secrecy and corporate loyalty govern relations between firms and their customers, suppliers, and competitors, reinforcing a regional culture of stability and selfreliance. Corporate hierarchies ensure that authority remains centralized and information flows vertically. The boundaries between and within firms and between firms and local institutions thus remain far more distinct.

Because MIT performed more defense research in World War II than any other U.S. university, the postwar industrial boom along nearby Route 128 had a distinctly military flavor. In the 1950s and early 1960s, defense electronics firms such as Raytheon, which emphasized secrecy rather than collaboration, dominated the region.

But another industry, computers, soon came to the fore. MIT graduate Kenneth Olsen founded the area's first major computer firm, the Digital Equipment Corp. (DEC), in Maynard, Mass., in 1957. Twenty-five more computer ventures started up during the 1960s, and another twentythree, including Prime Computer and Computervision, were founded during the 1970s. By the end of that decade, the region's computer makers specialized in one class of machines, minicomputers, whose capacity, performance, and prices were lower than those of mainframes but higher than those of personal computers. DEC was the nation's largest producer of these machines.

As the fast-growing minicomputer firms took their place alongside the defense contractors, they expanded the local supplier base. By 1975 the technology complex along Route 128 employed close to 100,000 workers.

Despite the forward-looking technology it engendered, Route 128 was marked by a deep conservatism in both social and business practices. The social world of most New England engineers revolved around the extended family, the church, schools, tennis clubs, and other civic institutions. Their experiences did little to cultivate the strong regional or industry-based lovalties that unified the members of Silicon Valley's technical community. Most engineers were from New England, and many had attended local educational institutions. They generally went home after work rather than getting together to gossip or discuss their views of markets or technologies.

New England conservatism also shaped the organization of local labor markets and patterns of entrepreneurship. Stability and company loyalty were valued over experimentation and risktaking. Whereas interfirm mobility became a way of life in Silicon Valley during the 1960s and 1970s, Route 128 executives preferred professionals who were "in it for the long term." The Massachusetts High Technology Council (MHTC)—the business association that emerged in the 1970s to represent the interests of Route 128 firms—differed fundamentally from the Santa Clara County Manufacturing Group, which worked to develop harmonious relations with the local public sector. The MHTC devoted most of its efforts to lobbying for state and local tax cuts that undermined the ability of the public sector to contribute to industrial development.

In this conservative milieu, entrepreneurs created organizations characterized by formal decision-making procedures and management styles, and conservative workplace procedures, dress, and work styles. A handful of companies consciously sought to avoid corporate hierarchies. DEC, in particular, pioneered a management model based on organizational decentralization and a participatory culture. But the old-line electrical producers such as RCA, General Electric, and Sylvania, and the newer electronics producers along Route 128 such as Honeywell and Raytheon, adopted a far less flexible organizational model. Corporate divisions were generally subject to the final authority of a central office. Even at DEC, Olsen and a small number of powerful senior committees retained final authority for all important decisions.

Following the model of the traditional vertically integrated corporations from which many Route 128 firms drew their managers, the region's minicomputer producers internalized as many operations as possible. They designed their computers or electronic systems, manufactured most of their own components, peripherals, and subsystems, wrote their own software, and performed final assembly. They also controlled all marketing, sales, and support services. This structure allowed them to profitably manufacture standardized systems in large volumes—a practice known at the time as "pumping iron"—but also hindered their ability to recognize and adapt to changes in computer markets and technology.

TRYING TIMES

In the late 1970s and early 1980s, when both Silicon Valley and Route 128 were booming, it would have been difficult to judge the relative merits of an industrial system based on regional networks versus one based on independent firms. Yet major market shifts in the 1980s severely tested these models, throwing the largest producers in both regions into crisis.

The biggest mistake of Silicon Valley firms was to abandon the system that had led to their success. In a headlong race to serve fast-expanding markets for standardized memories and microprocessors, northern California's semiconductor firms transformed themselves and the regional economy by shifting to mass manufacturing. Embracing the prevailing management models of the day, they saw this shift as an inevitable stage in their industry's maturation. The practices of open exchange and informal collaboration that had allowed them to design new products and develop innovative applications were of little value in manufacturing large volumes of standard products. As they standardized products and processes to cut unit costs and move down the learning curve, they frequently abandoned the local culture and relationships that had been the source of their earlier dynamism. They distanced themselves from customers, antagonized equipment suppliers, and adopted management hierarchies. And by relocating the fabrication of semiconductor wafers to lower-cost areas in the United States, they segmented the production process, separating R&D from manufacturing and assembly.

Silicon Valley's chipmakers transformed their own structures—and abandoned the region's networks—just as Japanese semiconductor companies were changing the rules of the game in high-volume production. The California firms embraced the mass-production strategies that had dominated in the United States during the postwar era at the precise moment when their Japanese competitors were developing a more collaborative model of semiconductor manufacturing—one that allowed them to consistently improve chip quality and lower costs.

Japan's incursion was swift. U.S. firms controlled the memory business throughout the 1970s, yet in 1984 Japanese producers took an early lead and captured virtually all of the market for 256K dynamic random-access memories (DRAMs). When U.S. producers began high-volume production of the devices in 1985, price cutting was so fierce that they suffered unprecedented financial losses. By 1986 all of Silicon Valley's producers had dropped out of DRAM production. Japanese firms quickly came to control high-volume markets for other memory chips as well, and by the end of the decade they were the world's leading producers of semiconductor memories.

The loss of the memory business spurred the worst recession in Silicon Valley history. Observers concluded that Silicon Valley was "losing its edge"—that the semiconductor industry was going the way of the nation's auto and steel producers at the hands of Japanese competition. One in

every five local semiconductor employees lost his or her job during the layoffs and plant closings of 1985 and 1986. As the downturn spread to related sectors in the region, more than 25,000 jobs were lost, three-quarters of them in high-tech industries.

Because they had distanced themselves from customers, the leading Silicon Valley producers failed to do what they had once done so well: identify new trends and markets. They failed to capitalize on key developments such as semicustom integrated circuits and chip sets (which integrate the functions of an entire computer system onto a small number of customized integrated circuits). It took a new generation of start-ups in the 1980s to develop these technologies.

Meanwhile, Route 128 was going through tough times of its own. Faced with shrinking markets, the region's minicomputer producers all reported big drops in earnings. More than 50,000 technology jobs were lost along Route 128 during the late 1980s; the region was so dominated by large minicomputer firms that, like Silicon Valley, it followed its leading producers into crisis. In this case, the competitive threat was not from Japan but from U.S. makers of personal computers and workstations, including—ironically—many start-ups based in Silicon Valley.

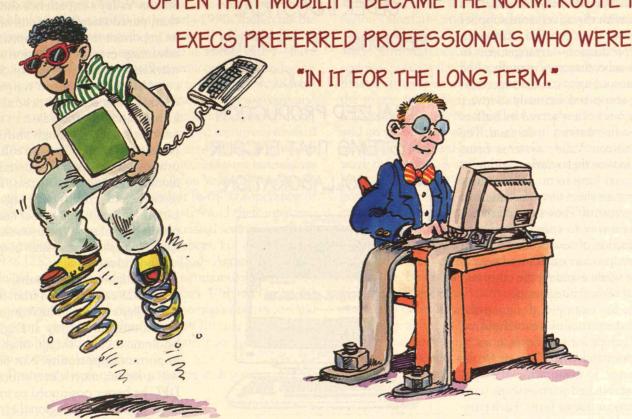
Initially, most Route 128 minicomputer firms did not recognize microprocessor-based technologies as a threat. They dismissed microcomputers as either irrelevant or silly, much as IBM had dismissed the threat of minicomputers two decades before. The minicomputer makers also refused to abandon their proprietary architectures and operating systems, despite growing evidence that customers preferred the flexibility of open systems, which let customers run software produced by other vendors and allowed different programs to work together. When producers like DEC and Data General finally entered the personal computer and workstation markets, their self-sufficient structure required them to develop all system components internally. Their microcomputers were often several years late.

By the end of the 1980s, Route 128 had ceded its position as the locus of computer innovation to the West Coast just as Silicon Valley had lost the commodity memory business to more efficient Japanese manufacturers. Of the minicomputer makers, only DEC remained profitable during the late 1980s. By 1992 Prime had been acquired and its computer operations discontinued, Wang had filed for Chapter 11 bankruptcy protection, Data General had undertaken a major reorganization in the face of a bleak future, and DEC faced unprecedented financial losses.

THE COMEBACK TRAIL

In the years following the high-tech manufacturing slump of the 1980s, Silicon Valley rebounded strongly, while Route 128 failed to recapture its former glory. The reason was, quite simply, that northern California start-ups returned to the principles of cooperation and collective innovation on which the region's success had been based.

SILICON VALLEY ENGINEERS SWITCHED FIRMS SO OFTEN THAT MOBILITY BECAME THE NORM. ROUTE 128



Entrepreneurs like T.J. Rodgers of Cypress Semiconductor and Gordon Campbell of Chips and Technologies quit jobs at large semiconductor firms in frustration with their employers' growing isolation from customers and unwillingness to pursue promising technologies. Along with legions of other talented engineers, they pioneered a new wave of innovative and responsive start-ups that would eventually challenge the region's established producers.

These start-ups forged a model of semiconductor production that once again built on the region's social and technical networks. They introduced specialized, designintensive devices that allowed them to define new markets and avoid the price wars that plague commodity producers. And many subcontracted the manufacturing of these products to avoid the high costs and risks of semiconductor fabrication.

While producers of standard memories manufactured millions of copies of a single design at low cost, start-ups such as Cypress Semiconductor, Cirrus Logic, and Maxim Integrated Products designed smaller lots of application-specific and specialty devices that added distinctive value to computer products. Cirrus, for example, designs chips that improve the performance of hard-disk drives and other PCrelated applications such as display graphics. Cypress introduced 56 new chips and chip subsystems in 1989 alone, and Maxim developed an average of 67 new products each year between 1983 and 1989. Collectively, these specialized semiconductors represented a \$1.4 billion market, and they were central to a new wave of computer-related products—many of them pioneered by local start-ups like Sun Microsystems, Silicon Graphics, and Conner Peripherals.

Silicon Valley's semiconductor and computer start-ups consciously attempted to avoid the cumbersome organizations of their predecessors. Seeking to create structures that rewarded individual initiative and preserved the focus and responsiveness of start-ups, these firms experimented with highly decentralized organizations. Once Cypress reached \$100 million in sales, for example, it adopted a venture-capital model. The firm invested \$65 million between 1987 and 1990 to spin off four satellite companies in closely related lines of business, including a chip fabrication facility and a design group to develop a secondgeneration microprocessor. Other firms, such as Sun, IDT, and Chips and Technologies, decentralized internally, creating autonomous business units to develop and market new products.

These organizational innovations allowed Silicon Valley's new chip and computer companies to introduce stateof-the-art products faster than their more integrated competitors. While new-product lead times in the semiconductor industry had traditionally exceeded two years, by the end of the decade firms like Cirrus Logic and Chips and Technologies had shortened them to nine months.

The diversification of the regional economy was the most visible sign that Silicon Valley was adapting successfully, but deeper changes were also under way. Established com-

puter-systems producers such as Hewlett-Packard and newer firms such as Sun Microsystems made a break with the adversarial supplier relations that typified American mass-production-arrangements in which subcontractors manufactured parts according to standard specifications, competed viciously to lower prices, and often served as buffers against fluctuations in demand. The new Silicon Valley systems firms came to view their relations with suppliers as long-term partnerships rather than short-term procurement arrangements. They saw collaboration as a way to speed the pace of introduction of new products and to improve product quality and performance while avoiding the costs and risks of vertical integration.

Sun, for example, designed the reduced instruction set computing (RISC) chips for its workstations in collaboration with Cypress Semiconductor. To manufacture the chip, Sun established partnerships with five semiconductor firms. Each partner used its own process technology to produce specialized versions that

had a common design but differed in speed and price. Sun encouraged these vendors to market the chips to its competitors and to develop clones of Sun workstations. In this way Sun extended acceptance of its architecture while its suppliers gained a new product.

In stark contrast to Silicon Valley's burgeoning production networks, Digital Equipment Corp. and the other minicomputer firms along Route 128 firms were so constrained by their self-sufficient structures that they adjusted slowly to new market conditions. And new technology firms failed to compensate for the crisis among the region's minicomputer producers. While entrepreneurial activity in Silicon Valley climbed markedly, the rate of start-ups along Route 128 actually dropped.

The performance of Route 128 companies founded during the 1980s was disappointing. By 1992, only 13 of the region's 1980s start-ups had surpassed \$100 million in revenues, versus 47 in Silicon Valley. While companies like Lotus Development Corp. and Stratus Computer recorded important successes, none matched the spectacular growth of Silicon Valley's Sun, Conner, or Silicon Graphics. The 1989 acquisition of Route 128–based Apollo Computer—which pioneered the engineering workstation—by Hewlett Packard symbolized the shifting center of gravity in computing from East to West. Today, Silicon Valley firms are once again pioneering new markets, in multimedia, video conferencing, and interactive educational products.

FOR THE COUNTRY'S OLDER INDUSTRIAL REGIONS, THE TASK WILL BE TO CONSTRUCT DECENTRALIZED PRODUCTION SYSTEMS THAT ENCOURAGE COLLABORATION.



TOMORROW'S SILICON VALLEYS

Silicon Valley's experience shows that, paradoxically, regions offer an important source of competitive advantage even as production and markets become more global. Silicon Valley continues to reinvent itself as its specialized producers learn collectively and adjust to one another's needs through shifting patterns of competition and collaboration. But spatial clustering alone does not ensure success. The separate and self-sufficient organizations of Route 128 hinder adaptation by isolating the process of technological change within corporate boundaries.

The high-tech companies of Route 128 can still learn from Silicon Valley's success. The reorganization now under way at Digital Equipment Corp. should offer an important opportunity. Not only will a leaner, more decentralized DEC be better positioned to integrate itself into the regional economy, but the firm has laid off thousands of experienced engineers

who can contribute to the growth of the software, networking, and supercomputer enterprises that emerged in the region in the early 1990s. New companies such as Chipcom and Wellfleet Communications appear to be pioneering a more collaborative business model than their predecessors. Although the continuing impact of defense cuts and the legacy of corporate autonomy suggest that regenerating the region will be neither easy nor fast, the depth of the region's technical skill makes the task achievable.

The challenges facing Route 128 mirror the challenges facing American regions and industry more broadly. Large parts of U.S. industry need to overcome the self-sufficient mind-sets and structures of an outmoded model of mass production. For these older industrial regions, the task will be to construct decentralized production systems that encourage collaboration as well as competition.

The promise of Silicon Valley–style production networks also carries important political implications. Debates over U.S. industrial policy tend to polarize between those who advocate national efforts to promote particular technologies or industries and those who believe that unfettered market competition will ensure industrial adaptation.

Neither of these approaches alone offers a convincing agenda. The widespread failure of science parks and other efforts by localities around the world to "grow the next Silicon Valley" underscores the limits of an approach that focuses solely on ensuring free flows of capital, labor, and

technology. Indeed, the main lesson of Silicon Valley is that it is the relationships between firms, not their simple presence, that matters. At the same time, the region's sustained technological dynamism in the early 1990s undercuts the urgency of simplistic calls for national industrial policy. American producers—many based in Silicon Valley—have regained their former strength in semiconductors and semiconductor equipment and continue to dominate world markets for personal computers, workstations, and software, and they have done so without major government intervention.

National policies that direct public resources toward particular technologies or sectors are further confounded as markets fragment and traditional industry boundaries blur. Because the dynamism of Silicon Valley lies not in any single technology or product but in the competence of each of the system's constituent parts and their interconnections, efforts to protect an individual sector often have perverse and unintended consequences. For example, the 1986 U.S.-Japan Semiconductor Trade Agreement, which placed a floor under the price of memory chips, was disastrous for U.S. computer makers. Ultimately, regions are best served by policies that help companies to learn and respond quickly to changing conditions, rather than policies that either protect or isolate them from competition or external change.

The most effective arena for setting such policies is at the

regional level—the level of metropolitan or county government, or even the government of a small state. It is at this level, rather than that of federal government, that a region's strengths and weaknesses can best be assessed by policymakers, businesspeople, and academic institutions alike. Although necessarily tailored to local conditions, regional policies should be designed to catalyze and coordinate, rather than directly manage, collaboration among the many actors that populate a regional economy. In Silicon Valley, a partnership between the City of San Jose and an association of software firms provides test equipment, lab space, and business services for the region's software developers. A still more ambitious program—Joint Venture: Silicon Valley, a consortium of local businesses, governments, and educational institutions-seeks to ensure the region's continued prosperity through a wide range of projects: coordinating the development of fiber-optic links within the valley, creating a center to support joint ventures, streamlining procedures for obtaining business permits, involving companies in improving science and math courses in the public schools. and many other initiatives.

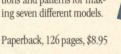
The task before places like Route 128 is to create similar forums that encourage the region's firms and other institutions to respond collectively to shared technical and economic challenges.

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Why Defense Reinvestment Won't Work

President Clinton wants to stimulate the economy by adapting defense firms to civilian manufacturing, a task for which they are not at all suited.

HE image of "beating swords into plowshares" is a powerful metaphor and a long-cherished dream, so it was only natural that the end of the Cold War raised public hopes that U.S. defense contractors could be converted to compete in the civilian market. The Clinton administration has encouraged these expectations, making "defense reinvestment"—the buzzword for using defense spending to boost the civilian sector—a key component of its plans to revitalize the U.S. economy. * At first it might seem as though the same U.S. companies that built sophisticated guidance systems capable of sending a smart bomb through the air shaft of an Iraqi bunker could certainly retool and make consumer electronics to compete with NEC or Panasonic. At the low-tech end of the market, the defense contractors that delivered millions of uniforms and billions of rations to the Persian Gulf

By Bruce D. Berkowitz

* Unfortunately, defense reinvestment is unlikely to live up to these expectations. The problem is not technology; it is management and organization. The specialized structure, procedures, and culture that defense contractors have developed.

would seem equally able to make clothing and shoes for export and domestic sale.

oped over the past 40 years to survive in the defense economy make them hopelessly ill suited for competing in commercial markets. This is especially true for large contractors, which receive two-thirds of all defense procurement funds. * No doubt some companies will be able to make the transition, and a few might find useful commercial applications for widgets built to military specifications. But these will likely be the exceptions.



1.4 million defense-related jobs would be lost by 1995—about 350,000 jobs per year. The Senate and the House both formed study groups to develop a response. One group, chaired by Sen. David Pryor (D-Ark.), a close ally of then candidate Clinton, recommended many of the basic elements that eventually emerged in the form of the TRP after the election.

The administration's policies are well intentioned, of course, and at first glance may even seem to make sense. As a means of capturing the excess energies of defense contractors facing military cutbacks, for example, the TRP has proved a rousing success. In the program's first year, ARPA received 2,763 proposals from defense firms seeking a total of \$8.43 billion—18 times the authorized funding level at the time.

Politically, the TRP and other defense reinvestment programs are brilliant. President Clinton is committed to developing a national industrial polis using the defense budget to promote icy, and administration officials such as Secretary of Labor Robert Reich and Science Adviser John Gibbons civilian R&D for the same reason Willie believe strongly that government should play an active role in selec-**Sutton robbed banks: because that's** tively promoting research to encourage economic growth. Yet public concern over the federal deficit makes funding any new program difficult. Changing the orientation of existing programs—in this case, defense programs—is far less difficult. In other words, the administration likely used the defense budget to promote civilian R&D for the same reason Willie Sutton robbed banks: because that's where the money is.

No less important, defense reinvestment addresses the concerns of regional interests. Defense production is concentrated in relatively few states, several of which are critical to winning presidential elections. California and Florida, for example, both have a large number of electoral votes and are usually closely contested. Several states with major defense industries are especially well represented in Congress: Michigan's Rep. John Dingell chairs the House Energy and Commerce Committee, and Texas and California field two of the largest congressional delegations. The representatives from these states favor defense reinvestment to ease the pain already inflicted by cuts in defense spending.

Economically, however, defense reinvestment is not so smart. Even though the TRP provides valuable photo opportunities for politicians to pose in front of defense plants, it and similar efforts to squeeze civilian applications out of defense R&D are unlikely to produce the overall benefits to the national economy that its supporters hope for. It is one thing to try to spin off benefits from already accomplished defense R&D; it is quite another to use the existing defense industrial base as the spearhead for economic growth.

Business the Pentagon Way

Defense contractors such as General Dynamics, Lockheed, and McDonnell Douglas are not like companies in the private sector such as Ford, Microsoft, and Proctor & Gamble. Large defense firms are highly specialized extensions of the government's procurement process. Doing business with the government, and especially with DOD, requires an organization with procedures and staff unlike those found in the private sector. The more defense business a company undertakes, the more specialized it becomes. Ultimately, contractors become very good at carrying out defense projects, but utterly unsuited to competing in the private sector.

Consider some of the quirks of defense contracting that companies must face to do business with the government:

maintaining the books. Federal regulations require government contractors to document all costs—labor, material, and overhead. Companies are regularly audited by the Defense Contracts Auditing Agency to calculate government-approved labor rates and ensure that overhead charges are lowable.

allowable.

Controlled profit. If he were alive today,
St. Thomas Aquinas would be a government
ords,
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overall scope of the project, and "fairness." Contractor negotiators learn how to play the game; they might contend that a project is risky, but they would never dream of arguing that they are entitled to as much as they can get.

■ Certs and reps. Contracts must also provide "certification and representation" that they are complying with affirmative-action regulations, honoring "buy American" clauses for material and subcontractors, using U.S.-flag transport, maintaining a drug-free workplace, and so on.

■ MILSPECs. Finally, goods built for the military usually must be built to detailed specifications that define not only the design and materials for a product but also the procedures for manufacturing and inspecting it. The company must maintain extensive documentation verifying that these specifications have been met.

To deal with the government's requirements, defense

contractors employ staff—and even maintain entire divisions—that do nothing but generate the necessary information.

There is an entire career path for "government contract specialists" who learn the skills peculiar to keeping firms in compliance with government regs and specs. The extra staff and procedures add to costs that make government contractors uncompetitive in the commercial market.

Although one might argue that defense contractors could adopt "commercial" procedures (less staff, less paperwork, and more efficient operation) when supplying commercial customers, and use "government" procedures only when they do a job for the military, it is difficult in practice. Once ingrained in a company's structure, Pentagon-required activities become virtually impossible to tease out on a case-by-case basis. Government requirements also shape a defense contractor's plant and machinery. A factory for a major defense system is designed so that the company can both build the system and comply with DOD standards as efficiently as possibly. Not only are the specified manufacturing steps built in, but the plant has DOD-spec parts bins, special inspection equipment, and facilities for DOD representatives. For these reasons, large corporations that have competed effectively in both the defense and commercial markets have usually established entirely separate companies for each, as Motorola and Boeing have done.

Another seeming option is simply to reform the DOD acquisition process so defense contractors do not have to be so specialized. In fact, many attempts at reform have been made. Vice-President Gore's "Reinventing Government" initiative was just the most recent. Before that, there was the Grace Commission of the 1980s and the Hoover Commission of the 1950s, both of which tried to streamline government operations. DOD itself sponsored the Packard Commission in 1984, and just last year the Defense Systems Management College published its own congressionally mandated study of defense acquisition and procurement procedures. By now everyone knows what the problems are. But these commissions and their recommendations have tended to receive a wave of initial approval, lots of favorable publicity, words of support from members of Congress and then wither away. The reason is not that there are evildoers in this process. Rather, the obstacles and hurdles in defense procurement reflect a basic underlying fact: public money is at stake.

Public money inevitably comes with strings attached. While some of the strings, such as the rules requiring the use of U.S.-flag carriers, may seem like craven attempts to benefit narrow special interests, many simply reflect the nature of bureaucracy. Large organizations such as DOD need standards to make sure that units and equipment can operate together. Still other strings, such as monitoring of compliance with civil rights legislation, are justifiable on social grounds. Thus, many of the inefficiencies of defense procurement make sense. It is just that we should not perpetuate the DOD style of management and organization throughout the economy.

That is the problem: the administration's defense reinvestment program assumes that military contractors will develop and sell commercial goods while remaining defense industries, when the two tasks are largely contradictory. In fact, the problem goes deeper than formal rules and regulations that add costs to a defense con-

tractor's business. It permeates the company's entire culture.

Culture Clash

contractors have developed to a

fine art the ability to respond to the

one customer that counts—the

Department of Defense.

Recently I negotiated a contract for a commercial project with a company that had carried out most of its work for the Pentagon. My counterpart kept mentioning that, as soon as we had signed a nondisclosure agreement, he would be glad to provide me with his cost structure and overhead

rates. The comment was telling. In the commercial world, companies do not reveal their costs to their customers; they protect this information to maintain an advantage over their competitors, as well as a negotiating edge over their customers. Buyers, meanwhile, usually do

not care what the company's costs are—they want to know the bottom-line price they will be charged.

This encounter illustrates the fundamental clash between commercial and defense "corporate culture"—the skills, knowledge, and norms the two types of firms have accumulated to survive in their respective domains. Consider the problem of how to develop and market new products, the basic material of economic growth. Private companies live or die by their ability to determine what the public will buy, year in, year out, and then to deliver the product at a price the public accepts. Successful companies know their market and respond effectively. Defense contractors are no less skilled in this respect; it is just that they have developed to a fine art the ability to understand and respond to the one customer that counts—the Department of Defense.

This difference is reflected in virtually every cultural dimension affecting how companies do business. Compare, for instance, two successful products: Lockheed's



could incorporate the best ideas into the Taurus.

Funding was another point of divergence. Defense contractors do not fund the development of major weapons systems; the government does. Big contractors are allowed to charge the government a fee on their contracts to conduct discretionary R&D that may lead to new systems ("independent research and development," or IR&D), and a fee for developing the huge, complex proposals required for major projects. For a large project such as the ATF, the government even issues contracts for developing a full-scale prototype—the YF-22 in the case of Lockheed, and the YF-23 in the case of McDonnell Douglas-at the cost of tens of millions of dollars each.

Because the profits of defense contractors are negotiated on the basis of what is "fair," they cannot accumulate large reservoirs of cash. They also tend to have few assets, often operating out of government-owned facilities. As a result, the major defense contractors have little experience or skill in raising private capital.

Ford, on the other hand, capitalized the Taurus through bonds, loans, and the sale of stock. To do so, it had to work with investment bankers and convince potential investors that its strategy was a winner (not an easy task, given Ford's mediocre performance and poorly designed products during the 1970s). Indeed, this is just what the commercial divisions of Boeing and McDonnell Douglas must do when financing a new air-

liner. For such a project, the process is difficult and risky—it's called "betting the company"—and if the product fails, the company may have to exit the market. This is why Lockheed, whose L-1011 lost out in the market to the McDonnell Douglas

DC-10—is no longer in the airliner business.

Another difference between the military and commercial markets is the role of testing. The two ATF prototypes engaged in a highly structured "fly-off," partly to identify the better aircraft and partly to deter-

mine whether the contractors had met the stated performance requirements. Because a failure to meet these requirements can sometimes spell the cancellation of a program, the goal of military testing is to avoid failure at all costs. In the commercial world the objective of testing is usually just the opposite: developers want the product to fail, so they can identify weak points and

remedy them cost-effectively. In one type of testing, auto manufacturers hire drivers in northern Canada to start, stop, and restart their products repeatedly in winter conditions: in between, the drivers tug at the

switches and the trim inside the car to see if anything gives way. On the Ford prov-

ing grounds in Michigan, Taurus prototypes were driven until they broke.

Finally came the challenge of making the new product a success. For Lockheed, that meant demonstrating to a DOD selection board that it had met the evaluation criteria better than McDonnell Douglas, then lobbying Congress to ensure that the program would be funded. One thing Lockheed didn't have to

worry about was foreign competition.
The company is protected by "buy American" laws, and the very thought of the U.S. Air Force or Congress granting billions of dollars to Dassault or Saab (the leading European fighter manufac-

turers) would have been ludicrous.

A single factor determined whether the Taurus was successful: whether Ford sold enough cars to justify its investment. Ford had to convince hundreds of thousands of individuals that they needed a new car, and that it should be a Taurus. In many cases, these potential buyers were driving something other than a Ford, and many of them had driven foreign cars for years.

The point is that both the F-22 and the Taurus are excellent products, yet the skills necessary to bring the F-22 to the flight line were different from, and largely incompatible with, the skills for marketing the Taurus. Organizational cultures like those in the defense contracting community—cultures built up over generations of management—are notoriously difficult to change. The organizational skills Ford relies on to succeed in the commercial market are notoriously difficult to develop.

Just as the formal requirements for DOD contracting serve a useful purpose, there are reasons why we would not want Lockheed and other large defense contractors to change. The services need companies they can rely on to carry out complex specifications to the letter. One could also argue that despite the alleged problems of the "revolving door," the close working relationship between DOD and its contractors has produced the most effective weapons systems in the world.

The "Scorched Earth" Approach

Good as they are at what they do, defense contractors are so ill suited for competing in the private sector that defense conversion and technology transfer should be considered no more than "targets of opportunity." That

nstead of propping

up defense firms that are

no longer needed, it would be more

efficient and humane to let them

die a natural death.



is, if we need to invest in specialized technology for defense, then common sense dictates that we should take advantage of any commercial applications that might be possible.

Unfortunately, current policy goes beyond common sense, attempting to preserve

and the Ford Taurus are excellent

produce them are largely

incompatible.

much of the defense industrial community under the misconception that this is an efficient way to produce technology and products that will boost the civilian economy. In reality, even though defense spin-off may produce some benefits, the best source of civilian products is products, vet the skills necessary to now and always has been civilian industry.

Instead of attempting to prop up defense firms that are no longer needed, it would be more efficient—and, in the long run, more humane—to let them

die a natural death. If a manufacturer of tanks is receiving too few orders to remain profitable, there is little sense in giving it aid to switch over to manufacturing tractors. It would be better to let the firm go out of business and leave the task of building tractors to companies that know how to build tractors. The people, technology, and facilities would not disappear; assuming demand for their services was high enough, they would likely be acquired by a company already doing business in the civilian sector. The government could provide relief to tide over the workers until they found new positions, but trying to preserve the company in the process is grossly inefficient. The goal should instead be to minimize and consolidate firms dedicated to defense R&D and manufacturing, maintaining the base necessary to provide specialized expertise and manufacturing, but no more.

Critics might point out that this "scorched earth" approach to defense conversion will result in the loss of organizational experience, but that's exactly the point. It is the defense industry's organizational experience that stands in the way of its success in the civilian world.

A similar argument can be made about dual-use technology. The defense budget will inevitably spur technical development, if only because it is so large and so heavily concentrated in high technology. But dual-use initiatives would be more likely to pay off commercially if they focused on providing subsidies for taking products that had been designed to compete in civilian markets and adapting them to military use, rather than trying to find commercial applications for defense technologies, as is now the case. DOD itself could sponsor programs that concentrate on identifying features of commercial products that need to be modified for military use, and then changing those features accordingly.

If the administration were to abandon its policy of artificial life support for defense contractors, it would need some alternative strategy to compensate for cutbacks in defense procurement. One way would be to encourage defense contractors to create spin-off companies that are free from the constraints of working for

> DOD. At the very least, the government should require an ailing defense contractor to establish a new company, organized to perform efficiently in the civilian economy, as a

condition to receiving aid.

The government might accelerate the formation of spin-offs by instituting a program of grants administered by the Department of Commerce, under which DOD contractors would establish new companies to exploit defense technology. Unlike the defense specialists who run the Technology Reinvestment Project, Commerce officials deal every day with civilian compa-

nies and are in a much better position to identify technology with commercial uses.

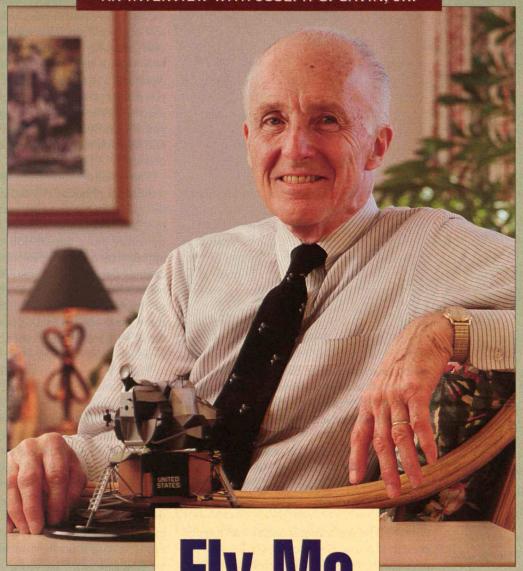
Yet the most effective measures for creating jobs for displaced defense workers are those—like low interest rates, cost-effective regulation, and predictable tax policies—that promote an environment generally favorable to economic growth. The government could spur industrial R&D by cutting the capital gains tax, thereby boosting investment in start-ups, and by permanently rein-

stating the R&D tax credit, a move that would encourage existing companies to conduct more research.

Before the nation invests heavily in the defense sector to produce new job-creating economic growth, it is worth remembering that, as large as it is, the defense sector constitutes only about 7 percent of the total economy. It seems inevitable that economic growth for putting defense employees back to work is more likely to result from the 93 percent of the national economy that is not based on defense.

The market approach may not seem as "dynamic" or "aggressive" as the current policy. A big attraction of the Clinton approach, after all, is that it satisfies both the public's demand that their officials "do something" and the desire of politicians to be seen doing something. Defense reinvestment also provides an illusion of predictability and rational planning. The problem is that in the real world, economic development is rarely so neat.

AN INTERVIEW WITH JOSEPH G. GAVIN, JR.



E celebrate this month the 25th anniversary of an auspicious event: on July 20, 1969, NASA astronauts Neil Armstrong and Buzz Aldrin became the first human beings to land on the moon. That event not only remains forever inscribed in the minds of the world's observers cheering the mission on but also has become the gold standard for vir-

Fly Me to the Moon

JOSEPH G. GAVIN, JR.,

THE ENGINEER WHO LED THE LUNAR

MODULE PROJECT THAT ENABLED

NEIL ARMSTRONG TO TAKE HIS

"GIANT LEAP FOR MANKIND,"

TALKS ABOUT THE HISTORIC

MISSION AND ITS AFTERMATH.

tually all other technological, and even social, efforts: "If we can get to the moon, why can't we...?"

Few know what it took to pull off that complex and painstakingly-prepared-for achievement, as well as its lessons, applications, and limitations, better than the engineers and technicians who built Armstrong's marvelous machine, the lunar module (LM, pronounced "lem"). Just ask



the person who led them—Joseph G. Gavin, Jr., director of the Lunar Module Program at Grumman Aerospace Corp. (the vehicle's prime contractor) from 1963 to 1972. Gavin, an engineer with degrees in aeronautics from MIT who had been with the company since 1946, oversaw the design, manufacture, and testing of all 12 lunar modules ultimately produced, including those for the 6 Apollo missions that went all the way to the moon. Gavin later served as Grumman's president and chief operating officer.

To help commemorate the anniversary of the historic Apollo 11 touchdown, editor Steven J. Marcus and managing editor Sandra Hackman interviewed Gavin, now retired, at his home in western Massachusetts. To talk with him on this subject is not only to relive the days of Apollo, in all of its engineering agony and ecstasy, but to be generally educated in the business of building "flying machines" as well as the present status and prospects of that business. Ironically, as we spoke, the company where he had spent virtually all his professional life was ending its days as an independent venture; the following week it was acquired by the Northrop Corp.

TR: How does someone become head of a project that will take the first human to the moon? Is experience in a special kind of management required?

GAVIN: The main requirement was experience in meeting engineering challenges—in particular, those encountered in putting together a complex high-performance flying machine. I was fortunate to be in the right place at the right time with the right background: I had previously been a project leader on naval-aircraft development projects, so I'd had some experience running large programs. In this case, the large program turned out to be a *major* program: at its peak the company had something like 7,500 people working on the LM, about half of whom were engineers.

TR: An important goal for managers, especially right now, is to keep costs down. Weren't things a little different in those days?

GAVIN: On paper, Grumman's contract with NASA allowed for some tradeoff between performance, schedule, and cost. But it took us only a couple of months to learn that there really wasn't any tradeoff. You absolutely had

to give priority to performance. Then you did the best you could to meet the schedule. Cost sort of came third. That may sound irresponsible, but when you think about it, that's the way things had to be for something like Apollo. If a major project is truly innovative, you cannot possibly know its exact cost and its exact schedule at the beginning. And if in fact you do know the exact cost and the exact schedule, chances are that the technology is obsolete.

This is one of those basic truths that are very difficult for politicians to understand. Much of the success in our program was due to the fact that Jim Webb, the NASA administrator at the time, did a superb job of keeping the appropriate committee members in Congress calm as the costs went up. His candor really helped: he laid it on the line at the beginning, saying that the project could eventually cost three times the original estimate. As things turned out, it did indeed cost about three times as much.

Today's Congress, concerned about excessive cost and delayed payoff, doesn't like to commit to long-term programs. It's very hard to get a commitment for two years, let alone ten. But a project of the scale of Apollo is going to take anywhere from eight to fifteen years. And it needs continuity of support. The worst thing that can happen is for an annual budget to oscillate, alternately firing things up and then slowing them down. Aside from the great inefficiency of constantly reassigning people, this undercuts morale. The really good people are going to say: "I wonder if I should stay with this?"

At the time of Apollo, there was great motivation to get to the moon because of the worry that the Soviets might get there first. The goal was broadly accepted, and the support was relatively constant and strong. One can even say that there was some "advantage" in the project having been promoted by a martyred president. Who knows what Mr. Kennedy might have done had he lived. But once this thing started going, there weren't too many politicians who were going to stand up and say "let's stop."

Dealing with Uncertainty

TR: The technical problems entailed in creating a vehicle that would land on the moon must have been prodigious, especially since designers couldn't be absolutely sure what astronauts would encounter.

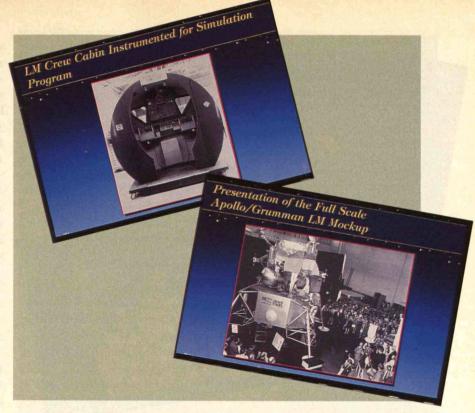
GAVIN: A lot about the moon's environment was indeed uncertain. For example, in 1965 a prominent astrophysicist told us the moon might have a layer of dust 10 meters thick that would swarm up over the vehicle when an astronaut tried to land. Others thought that the lunar surface would be slippery like ice, or that we'd be plagued by "potholes," So we developed a computer program, based on tests of a quarter-scale model of the lunar module, and we ran that program through some 400 different landing conditions. As a result, we built in a landing-gear stroke (the length to which it can be extended) of something like 28 to 30 inches. But it turned out to be overkill—I don't think we ever used more than 3 of those inches in any landing. And although we designed the ascent stage so that it could take off successfully even if the whole vehicle was leaning at a substantial angle, it was never more than 5 degrees off the level.

We found out that the 10-meters-of-dust hypothesis, even if it had been true, would have been a nonproblem, because the moon has no atmosphere. When the lander descends, the jet from the exhaust goes straight out sideways after hitting the ground, instead of coming up in a cloud as happens with a helicopter. Thus the dust would have been cleared. We did correctly anticipate, though, another strictly lunar situation: Here on earth, if you accelerate in a given direction and then take the throttle off, you'll gradually slow down because of the air resistance. On the moon, there is no air resistance, so if you accelerate in one direction you have to apply a reverse acceleration to stop your progress. This is a completely unnatural thing, something you have to learn. I had to "crash" the simulator a number of times before getting the hang of it.

We did a lot of simulation because the actual vehicle could not be flight-tested on earth. Aircraft designers had grown up with the idea that you take a new flying machine out on the runway, make a few taxi runs, and lift it off a little bit to see how it feels. If everything checks out, maybe a couple of days later you'll make a first flight. We couldn't do that here because the LM was designed to function only in the moon's environment.

TR: As in the case of the landing gear, was it generally true that you overdesigned to allow for unexpected events?

GAVIN: No, because the launch vehicles could carry only a limited load if they were to achieve



the needed velocity. Thus, for example, we had to design for the least possible use of energy—the more energy you need, the bigger the batteries get, the heavier the vehicle gets. So we had extremely close margins. That was especially problematic in our case, since we didn't have the luxury of alternative destinations. If an aircraft can't make it from New York to Paris, maybe it can get from New York to Dublin. But in the case of going to the moon, you either get there or you don't.

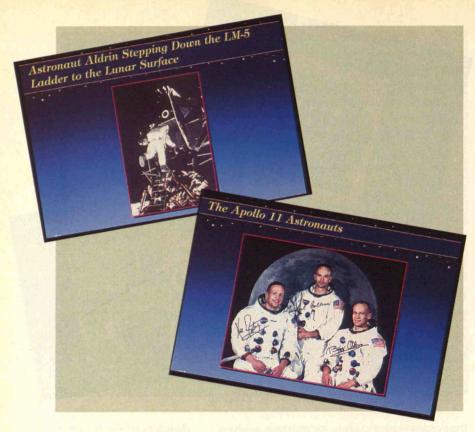
In an aircraft, you try to maintain an hour's fuel reserve. With the LM we were down to a 120-second reserve on fuel for firing the landing engine. And I think Neil Armstrong landed with only about 20 seconds left because, since there were boulders at the original site, he extended the glide path and landed about 25,000 feet downrange. Everybody in mission control was turning blue at that point, when they saw those 120 seconds begin to tick away.

But the margin wasn't as paltry as it might seem: the engines were carefully designed and evaluated as far as fuel consumption was concerned, and the conditions were ideal—there were no weather disturbances, no headwinds, or anything of that sort on the moon. You could afford to think in terms of smaller margins than, say, for an aircraft on earth.

TR: How could you be confident that the numerous components and subsystems of the

Builders of the lunar module had to rely on electronic simulators (above left) to anticipate flight performance.

Mockups (right) were built to assess the spacecraft's "human factors," including crew mobility in a cramped interior.



The crew of Apollo 11, from left: commander Neil Armstrong, command-module pilot Michael Collins, and lunar-module pilot Edwin "Buzz" Aldrin. Armstrong and Aldrin were the first and second human beings to set foot on the moon.

new machine would work together more or less as planned?

GAVIN: Complex systems have so many parts that if you measure reliability by multiplying all the probabilities of failure, the likelihood of success seems very low. But we looked at this notion and decided that it was too passive. We took the view that there's no such thing as a "random" failure. If you were patient enough, you could find the reason for every failure and make the necessary changes. And indeed we did. In the course of about 10 years of testing of individual components and subsystems, we found something like 14,000 anomalies, only 22 of which escaped definite understanding. And even in the latter few cases, we changed the design enough so that the element in question would definitely work. There's no such thing as "probably"—it's either going to be right or it's not.

Let me give you an example. The cockpit had a fair number of toggle switches, which had been used in airplanes for years and years. One of our young engineers decided to look inside. He had the shop cut up about a dozen of them, and in some he found a little loose pellet of solder. Now in one-g operation typical of aircraft flying in earth's atmosphere, that pellet is going to rest at the bottom of its little casing and probably not cause a problem. But in zero gravity it's going to migrate around

and might either fail to close the circuit or make a contact that isn't called for. Since the schedule didn't allow us to design a new switch, we developed a test that would tell us whether a pellet was present. We probably threw away better than a third of the switches, but we were certain that the ones we put in the vehicle were OK.

The moral of this story is that we had imbued in every project member extraordinary standards. They demanded to know exactly how each thing worked—and to be as sure as they possibly could that it would work when the time came.

The Human Touch

TR: Were the astronauts involved in the engineering effort?

GAVIN: Oh, sure. One or more astronauts were on hand at least once a month through all those years. And an astronaut sat in on every major change review. Having the astronauts around made a great difference to the overall morale of the technicians and engineers, who then developed a personal involvement: "I'm building this device to carry somebody I know, not some remote figure who's just a name." But this is something we had done with the development of all of our aircraft. We always had a company pilot involved to establish a personal tie.

The astronauts understood and appreciated this approach. One of the most emotional experiences I think I've ever had was when Freddie Hayes and Jim Lovell came back to visit after Apollo 13. The LM had served as the lifeboat that brought them back to earth after the service module (which normally would have supplied propulsion for entry to and exit from lunar orbit) became disabled. They went through the whole organization, aisle by aisle, to thank people.

TR: But what about the astronauts' impact on the actual designs? I'm thinking of the tradeoffs, dramatized in Tom Wolfe's *The Right Stuff*, between automation and human control.

GAVIN: Well, the astronauts always wanted to retain the ability to fly the machine themselves. But like most pilots, as they become accustomed to the automatic systems that are available, they feel better about them. Look at autopilots in aircraft: when they were first introduced, there was a great deal of skepti-

cism. It wasn't too long, though, before everybody was using them and depending on them.

TR: But pilots have the option to manually override them.

GAVIN: Yes, and that was true in the LM. As I mentioned earlier, Armstrong used the manual override on his landing. But even that was a compromise. The astronauts discovered in the simulator that they could set the vertical descent on automatic pilot and then manually fly the machine in the horizontal plane to pick the actual touchdown site. The automatic pilot allowed them to focus their attention.

The fact of the matter is that the vehicle could have landed completely automatically, though not in quite as nice a spot. After all, the Surveyor probes that went to the moon before Apollo were landed that way, and they survived.

Still, looking back, I don't think there's any question but that pilot control made sense. The astronauts could do things that certainly couldn't have been done remotely at the time. In Apollo 11, for example, an altitude reading was temporarily out because of computer overload: the astronauts decided not to abort the mission—as automated procedures would have indicated—but to be patient and wait for the reading to resume. It did. In Apollo 12, Pete Conrad could look out the window and see a Surveyor from a previous unmanned mission, thus verifying his landing accuracy.

And in Apollo 13, when an oxygen-tank explosion in the service module made a lunar landing impossible, the astronauts, with advice from mission control, had to improvise a number of nonstandard and even new rescue procedures in order to return to earth. If Apollo 13 had been run remotely, it would have been just a loss, period.

The role of the astronauts has been exaggerated in some accounts, but you'd have to say that they did something on almost every mission that couldn't have been done remotely. Therefore I think it was a wise decision to make those missions manned. If you start talking about Mars, however, that's a different argument.

TR: Do you believe that most missions today should be unmanned?

GAVIN: That depends on what you want to do. Because there are more things today that can be done automatically or remotely than was possible 25 years ago, you have to look very carefully at the mission to see why you'd need people. For example, if we were to go back to the moon to set up a base, I suspect you'd wind up having some people involved because the human mind is still the surest and quickest way to size up a complex situation and decide what to do.

But I've gotten into arguments with some of my colleagues about the business of going to Mars. What strikes me is the sheer weight that has to be put in earth orbit, beginning with the many tons of fuel that are needed not only to go out but also to come back. That looks to me, shall we say, discouraging. So I've proposed that if, after robotic exploration, we decide it's a good idea to send people to Mars, we should send them there to colonize. In other words, send them out without promising to bring them back. That way, the tonnage needed to fuel their trip becomes much more practical. Most of the supplies they'd need could also be sent, separately and precisely, on a one-way basis with existing boosters. Needless to say, nobody has stood up and cheered when I've presented this idea.

TR: Who'd volunteer for such a mission?

GAVIN: I'll bet you'd have so many volunteers you wouldn't know what to do with them. You'd probably see a lot of people in their 50s and 60s who are still good physical specimens. Going one way instead of two ways—given the amount of radiation likely encountered by the human body en route-would help them remain in good health.

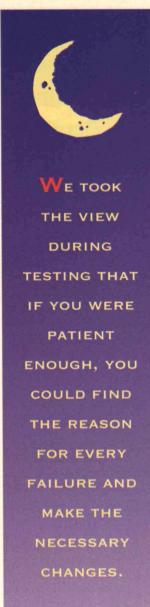
TR: Do you see the space station as an intermediate step to going to Mars?

GAVIN: Not really.

TR: Are you a skeptic on the space station?

GAVIN: Well, I'm torn on the space station. The problem here is that it has tried to be too many things to too many people, and the net effect is that no one group will stand up and say "We absolutely have to have it." I've always had this uneasy feeling about the space station that isn't going to make me popular with NASA. The fact is that it's not convincing enough—it really hasn't been justified on a priority basis.

Personally, I would put much higher priority on Mission to Planet Earth, where you have specially designed satellites assessing the earth's environment.





TR: What other projects should rank among the highest priorities for NASA?

GAVIN: For years now they've tended not to give aeronautics a fair shake. Everybody has assumed that atmospheric flying machines are so well understood that they've reached some plateau. But now that tremendous improvements in computational aerodynamics have made it possible to precisely predict the characteristics of a flying machine, I think more work should be done, for example, with vertical or short take-off devices—airplanes that also offer many of the advantages of helicopters.

The other thing, in my view, that NASA should take up—and that has been neglected for some time—is new expendable boosters. I chaired a National Academy of Engineering study a couple of years ago on expendable boosters, and we pretty much convinced ourselves that we needed a new family of them. You could say, "But we've got Titans, we've got Deltas, and we've got Atlases." They're obsolete, though—and there is limited ability to improve them. Meanwhile, the French Ariane has pretty much taken over the satellitelaunch business because the vehicle's designers have progressively reduced not only its construction costs but the army of people required to operate it.

There hasn't been a new rocket-engine design in this country since the shuttle, which was built to be largely reusable: the huge fuel tank is jettisoned, but the booster rockets and of course the orbiter are recovered. That design was based on a certain number of flights per year tied to required payloads. But the prediction on payloads was too optimistic—you really don't need the flight rate postulated back in the early 1970s. The result is that the shuttle costs too much per mission.

Yet it's possible, with the experience we've had, to build an engine that is much less expensive than the shuttle engine and that has almost as much performance and that would ideally fit the expendable booster. But there is no such effort under way, and we will pay for it.

The Long-Term View

TR: Do you see a major role for international collaboration in addressing these priorities?

GAVIN: There was a long period, lasting into the 1970s, perhaps, when we were clearly the leaders in technology. But I don't think that's true anymore. While you can go through a list, item by item, and say, "Well, maybe we're no longer ahead in this area but we're still ahead in that," the world has normalized on a technology basis more than most people realize. So international collaboration makes a lot of sense. But I'd be cautious because it's something that we in the United States haven't really understood how to do well, especially in its diplomatic aspects.

Fusion-energy research is a case of successful international collaboration that I was fortunate enough to have helped start, and the reason it works is that people feel they are participating on an equal basis. They have equal responsibilities and get equal returns. By contrast, NASA set up the space station program on the assumption that we'd be the leader who'd do the basic design and call most of the shots, and that the other collaborators would contribute as we deemed appropriate. In another case—the solar-polar satellite—we canceled the program rather arbitrarily without recognizing the impact on the Europeans. They're still angry about that.

One reason we have a problem is that our Congress does things on an annual basis, which makes it extraordinarily difficult for us to make a binding commitment. The Europeans have done things differently. When they built the fusion reactor at Culham in England, they set up a five-year budget that they would revise—knowing that nobody could predict what would happen in five years—at the end of the third year. Meanwhile, the three years provided a stability that we don't have. That longer-term view is one of the reasons why the Europeans have been catching up with us, and passing us, in so many areas.

The same long-term view, and the assumption that we're all in this together, applies to Japanese firms. Even when the famous "group consensus" principle is overturned by a company's leaders, they make great efforts to respect the staff. In the case of the Walkman, the consensus at Sony turned it down. The chief executive insisted on going ahead, but he and his managers then spent a lot of time working back through the troops to explain why they wanted to do it and how they wanted to do it, to get people on board.

TR: That anecdote sounds very much like the kind of communication you described for the LM project, where there was collaboration from top to bottom. I wonder if the Japanese may have learned some lessons there that we haven't.

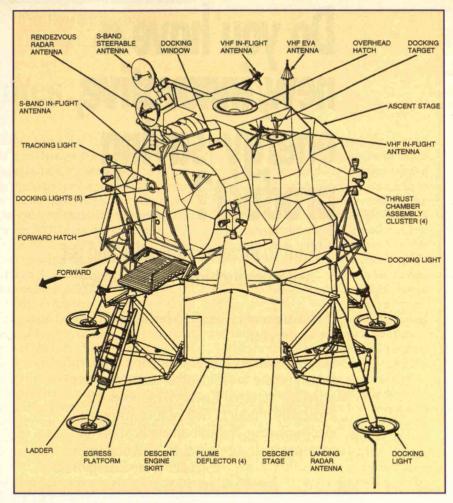
GAVIN: I've worked for only one company; I went to Grumman right after getting out of the Navy in '46 and I spent 40 years there. Grumman had—and I use the past tense because I don't know what it's like today—a different culture from any other company that I've ever done business with: all employees felt that they had a stake in the company's affairs and were encouraged to participate in decision making. Government agencies accused us over the years of being paternalistic, but the fact is that we took care of our people and anybody in the organization felt free to call up anybody else. If you wanted to talk to the president, you called up the president. The management of the company had an open-door policy that said anybody can come in and talk to the boss. And they did. We also tended to look well beyond the next quarter's dividend. Because our business is one that takes time, we had to constantly be making some investments for the future. But in some domains, many of which affected us, the time horizon was shorter.

For example, we built the X-29A, a little airplane with forward-swept wings, as a technology demonstrator. That is, it was never intended to be a prototype for any production run. The Air Force put up some money, NASA put up some money, and Grumman put up about \$40 million-about a third. And it was a huge technical success. But shortly after the airplane was demonstrated, a senior analyst from a major New York brokerage firm came out to visit Grumman, and naturally we talked about the X-29A because we were so proud of it. Well, when he heard what we'd invested in it, he excused himself, went to the telephone, and changed that firm's buy recommendation to a hold. And within two days Grumman stock went down 10 percent.

In the analyst's view, since the investment didn't lead to production, it was money down the chute, even though we had explained that the demonstrator was our ticket to any future high-performance flying-machine business because it had the most complex and versatile control system ever put together. We were looking 10, 15, maybe even 20 years into the future while he was worried about his investors' short-term profits.

TR: Couldn't the government cultivate a longer-term view, as it did during Apollo?

GAVIN: I don't know how you'd do that today. There aren't enough people in Congress who have secure seats anymore.



One of the supporters of the Apollo program was quite a remarkable individual named Olin Teague, known as "Tiger" Teague. He came from a district near Austin, Texas, and not a cent of the Apollo investment went into that district. I got to know him after the Apollo program. He used to tell me that when he went home, some of his neighbors would come by and say, "Olin, why are you shooting all that money off into space?" He'd answer, "Well first of all, it's not going off into space. It's being spent right here on earth. And second of all, we're doing it because I think the country ought to do it." There aren't too many members of Congress today who think like that and have the power to back it up.

TR: What do you think of the prospects for converting defense firms from military and aerospace activities to commercial ventures?

GAVIN: I've had some first-hand experience with that: Grumman did business for a time making buses (which became a disaster), post-office trucks (a huge success), and even solar hot-water systems (which prospered as long as

"Despite its ungainly appearance," Neil Armstrong told a standing-room-only crowd at an MIT lecture this past May, "the lunar module was a superb flying machine."

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the tax incentive was in force). But those are exceptions. The problem is the nature of the aerospace business, where you have to spend years and years designing things. When you're betting somebody's life on the outcome, you get into a methodology that is too expensive for commercial products—unless you want to create a Mercedes. You cannot compete by trying to produce a Chevrolet.

That doesn't mean there aren't some things you can pick out from the defense business and apply in other areas. An awful lot of things have come out of aerospace that have been successfully used in other industries.

For example, sophisticated tools for structural analysis were developed to design the boosters and the fuel tanks for the lunar module; the John Deere Co. later used these techniques to save an astonishing amount of cast iron in producing its heavy machinery. And when you fly across the ocean, the commercial airplane's guidance system is a direct descendent of the system used not only in Apollo rockets but previously in intercontinental ballistic missiles.

But you almost have to have a separate location and a separate workforce, as we did with the postal truck, to make a commercial product from these spinoffs that will sell in the market. Short of that, the products of the "converted" aerospace company need a top-of-the-line aura. If you can create that aura, you can offer something pretty sophisticated that some folks will probably buy. But I was never able to figure out how to capitalize on that.

People who say "convert the defense industry" don't really understand what they're proposing: it's more accurate to say that there's much there that can be directed to some useful commercial purpose. But rather than convert, I think you can consolidate the industry—much like what has happened in Europe, where there are now only a few, though large and multifaceted, aerospace companies.

THE HUMANE ENGINEER SAMUEL C. FLORMAN

Hard Times, Silver Linings

The words are from Shakespeare's As You Like It, spoken by the good Duke Senior, whose kingdom has been usurped by an evil brother. Trying to cheer up his fellow exiles, the duke extols the benefits of their rigorous life in the Forest of Arden.

I thought of this scene recently when reading about the distress of engineers who have lost their jobs and had trouble finding new ones. Unemployment among engineers in the United States, which for several decades averaged about 2 percent, has jumped in the past two years to around 4 percent. This level is unprecedented, as is the anxiety that has come in its wake. Even in the "crisis" year of 1971, engineering unemployment reached only 2.8 percent, and

improvement came swiftly.

The magnitude of the problem goes far beyond the numerical measure. R. A. Ellis, director of manpower studies for the American Association of Engineering Societies, estimates that at least 10 percent of engineers have experienced unemployment in recent years, with most finding new positions when discharged from old ones but still undergoing considerable trauma. Further, the impact on engineering students is dispiriting. Some prominent schools report that more than 40 percent of their graduates are without employment at graduation, and that half of these are still unsettled six months later—almost twice the rates recorded in 1989.

If this particular adversity brings with it "sweet uses," what might they be?

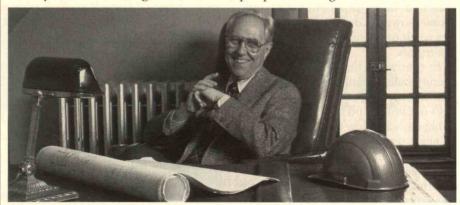
Admittedly, no abstract social improvement can offset the immediate hurt to individuals. But having said this, one can see potential benefits in the current crisis, some of them exciting to ponder. The good news is summed up in a headline in a recent issue of ASME News, a publication of the American Society of Mechanical Engineers: "Engineers are Finding New Directions for Skills." The article relates how "career transition workshops" have helped engineers recognize the multitude of occupations for which their talents and experience have

qualified them. Of course, some engineers have always been adept at switching specialties, finding their way into sales, management, and just about every other career path imaginable. But adversity has helped sharpen their awareness of the breadth of their competence.

At the same time, a heightened appreciation of what engineers can offer an organization is opening up new sources of employment. Banks, for example, are recruiting engineers because of these professionals' knowledge of information systems. Investment firms and financial houses of all sorts are seeking engineers to do research because of their general quantitative and problem-solving skills. Computers have transformed the world of securities trading, and engineers are helping create ever more sophisticated modeling techniques.

Anderson Consulting, the information systems consulting arm of the curtailed their hiring of engineers, small companies—leaner, quicker, and more responsive to market changes—have shown gratifying resilience. According to Robert K. Weatherall, director of the Office of Career Services at MIT, placement directors around the nation have noted that these small firms are looking for "bright, all-round, practical" engineers. "Specialists" are out of favor. Indeed, the more specialized branches of engineering, such as aeronautical, materials, nuclear, and ocean—have suffered the most during the current downturn.

These events lend support for a curriculum that many people have long been urging: a core of science and basic engineering disciplines, thoughtfully blended and taught with respect for design and practicality, and further integrated with a measure of humanities and social sciences. Specialization should be largely postponed until graduate school. Grad-



Arthur Anderson accounting firm, has started employing engineers by the hundreds. Management consultants, too, are looking to engineers: Last year, McKinsey & Co. offered jobs to 17 advanceddegree candidates at MIT, 13 of them PhDs. Environmentalism, an ever-growing complex of concerns and activities, has brought corporate and government agency recruiters to the campus; this helps explain why chemical engineers have been getting jobs in spite of weak demand from the chemical industry. Similarly, civil engineers have benefited from an accelerating concern for the nation's infrastructure.

While many large corporations have

uates of such a program would be versatile in the best and most comprehensive meaning of the word. Engineering may yet become the education "of choice" in the United States, as it is in many parts of the world. Of course, this can only happen if all of us—engineering educators especially—are alert to the changes that are occurring in the workplace. Perhaps for U.S. engineers, as for the exiles in the Forest of Arden, the uses of adversity may indeed turn out to be sweet.

SAMUEL C. FLORMAN, a civil engineer, is the author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, Blaming Technology, and The Civilized Engineer.

THE ECONOMIC PERSPECTIVE BENNETT HARRISON

Strategic Networking for the People

HE streets of central Newark, N.J., might seem light-years removed from the high-powered world of international corporate alliances. Not so. In this mostly black, low-income area, a community development corporation called New Community Corp. (NCC) is applying the model of strategic networking that has become so popular in business these days. By hooking up to a database on employment opportunities operated by the state government, NCC provides more effective job training and placement. NCC is also linked to the Career Center at the Port Authority of New York and New Jersey, which has hired a Los Angeles-based company to set up shop in New York City to recruit and train employees for the hundreds of companies doing business in the World Trade Center in lower Manhattan. NCC is also tied in to a Port Authority project that helps small, minority, and women-owned construction businesses get work on infrastructure projects in the region.

In contrast to the 1960s, when community-based organizations sought selfsufficiency, the best of today's groups find networks and alliances indispensable to achieving their objectives of bringing resources into inner-city neighborhoods and helping their constituents find a place in the wider urban economy. For three years now, I have been visiting networks through which economic development groups in poor communities are getting connected: to one another, to mainstream institutions such as community colleges and government agencies, and to big companies that can provide community development corporations with subcontracts and their communities with jobs.

Consider the largely Mexican-American COPS/METRO Alliance, based in San Antonio. The organization has negotiated contracts with specific companies to create jobs. COPS/METRO provides customized training for these jobs, relying on specialists recruited from the Air Force. (The U.S. military is generally considered to have the best job-

training programs in the nation.) The alliance is now branching into other cities in Texas.

Similarly, the mostly Chicano Center for Employment Training (CET) in San Jose develops training programs tailored to the needs of particular companies, raising the probability that trainees will wind up with real jobs. CET, the most successful such organization in the country, owns branch operations throughout California and in several other states. It is also forming alliances with other community-based groups, including Newark's NCC. Through these connections, organizations all over the country will be able to tap into CET's expertise—adopting that organization's techniques while getting guidance from the people who have made the programs work so well.

Citywide networks of neighborhood development organizations are also

to see that its constituents get a fair share of those jobs. Through sharing of projects and timely information, council members who once fought turf wars to obtain the best jobs for their constituents are now building bridges among the city's diverse minority neighborhoods.

Technological change is serving as a catalyst for these alliances. The sharply declining cost of computing and telecommunication has allowed local groups to exchange information and coordinate activities over great distances, enabling the unprecedented collaboration.

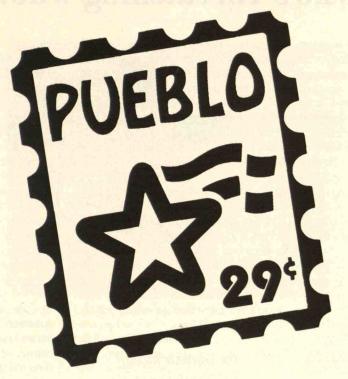
Community alliances differ in particulars from their corporate models, but a common underlying principle appears to be at work: successful organizations are forming networks as at least a partial substitute for trying to grow ever larger and do everything themselves. This trend has enormous implications for economic development policy.



making connections to powerful mainstream institutions located outside the low-income community. The Pittsburgh Partnership for Neighborhood Development, for example, works closely with the city's biggest banks to reduce discrimination in mortgage lending and free up the flow of bank funds into real estate and commercial development in the city's neighborhoods. The Chicago Jobs Council—itself a network of dozens of local groups ranging from public-housing tenant organizations to YMCAshas begun a project to identify publicsector employment opportunities for people of color. The council plans to apply its well-exercised political muscle Rather than dealing only with companies, community organizations, and local governments on an individual basis, national policymakers should focus their attention on providing incentives for these entities to work cooperatively in training and placing workers from low-income areas in desirable jobs.

BENNETT HARRISON teaches economic development at Carnegie Mellon University's H. John Heinz III School of Public Policy and Management. His newest books are Lean and Mean: the New Landscape of Corporate Power in the Age of Flexibility, published in May by Basic Books, and Building Bridges, published in June by the Ford Foundation.

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FORUM MARTIN HART-LANDSBERG

Who's Threatening Who?

ORTH Korea is "a ruthless and irrational dictatorship," "an economic and political disaster," and, now that it has acquired nuclear weapons, "the greatest threat to U.S. global interests and the peace and stability of the world." So say most U.S. policymakers. The administration also maintains that North Korea must give up its nuclear weapons and accept regular inspections of its nuclear facilities in accord with the nuclear Non-Proliferation Treaty (NPT). The evident strategy for achieving

this goal: United Nations-imposed economic sanctions against North Korea.

North Korea says it would interpret such sanctions as an act of war. In response, the United States is strengthening its military presence in the region. Are we headed down the road to another Korean War, this time with nuclear weapons on both sides?

Before events pass the point of no return, we had better make sure we understand what is really at stake in this confrontation. A look at recent history

will shed some light.

North Korea signed the NPT in 1985 but refused to agree to international inspection of its nuclear facilities as long as the U.S. maintained troops and nuclear weapons in South Korea. The inspection issue remained on the political back burner until 1990, when the United States charged North Korea with trying to develop nuclear weapons. North Korea denied the charge. Tensions grew. One example of how serious the situation became: the South Korean military twice proposed strikes

pected nuclear-weapons facilities.

Just when military confrontation seemed inevitable, a series of events raised hopes for a new era in North Korea-U.S. relations and peaceful reunification of Korea. First, both North and South Korea entered the United Nations.

on North Korea in 1991 to destroy sus-



To resolve
the nuclear faceoff
with North Korea, the
United States will have to
rethink its singleminded
and hostile approach.

A short time later, the United States announced the withdrawal of its tactical nuclear weapons from South Korea. North and South Korea then signed two major non-aggression and reconciliation agreements. Finally, North Korea announced its willingness to permit the International Atomic Energy Agency (IAEA) to inspect its nuclear facilities.

Six separate inspections occurred from May 1992 to February 1993. Unfortunately, the good will created by this development was soon shattered by new U.S. charges. While IAEA inspectors found no evidence of a nuclear-weapons program, their analysis of North Korea's nuclear waste raised questions about whether the government was understating the amount of weapons-grade plutonium it possessed as part of its power program. The IAEA and North Korea met to resolve what the latter called a "misunderstanding." But these meetings

came to a halt when the CIA publicly declared that North Korea had two secret waste sites where significant quantities of plutonium were stored and that the country was likely already in possession of one or two nuclear bombs.

Pressured by the CIA and possibly smarting from criticism of its handling of Iraq, the IAEA requested permission to make a "special inspection" of the two sites. The North Koreans refused, arguing that the IAEA had no right to inspect non-nuclear military facilities.

Angered by this decision, the United States launched, in March 1993, a new round of its Team Spirit war games directed against the North. That country's surprising response was an announcement that it was withdrawing from the NPT. Although the United States threatened North Korea with U.N.-imposed economic sanctions if it did not fully comply with IAEA wishes, the North stood firm, rejecting any further inspections and placing its military on full alert.

The North eventually put its withdrawal on hold after U.S. and North Korean officials began meeting to discuss ways of reducing tensions. Finally, in March 1994, North Korea agreed to allow IAEA officials back into the country to inspect the seven original nuclear sites. The inspectors announced that because they were not allowed to examine the "glove boxes" used to handle nuclear material at one of the sites, they could not verify that the "continuity of nuclear safeguards" had been maintained since the last inspection. The North challenged this charge, arguing that glove boxes were never inspected in the past, and that the agreement authorizing this most recent IAEA mission did not contain permission for an expanded inspection process. Controversy erupted again in May when North Korea refused the IAEA's demands to

inspect spent fuel rods removed from its reactor. Once again the IAEA and the U.S. are using threats of a U.N.-sanctioned economic embargo to force North Korean compliance.

Not Serious about Negotiating Peace

U.S. leaders argue that if North Korea is allowed to flaunt the Non-Proliferation Treaty, it will be impossible to contain the spread of nuclear weapons. However, past U.S. actions raise serious questions about the sincerity of this argument. Israel, India, and Pakistan, all known to have nuclear weapons, have refused to sign the NPT or allow inspections of their nuclear facilities. South Africa, another country that had nuclear weapons but has renounced them, did not sign the NPT until 1992. In none of these cases has the United States sought tough international action. And there is no proof that North Korea actually has nuclear weapons: even U.S. State Department officials dispute CIA pronouncements on this question.

The U.S. military claims that special measures are warranted when dealing with North Korea because of the threat the country poses to both South Korea and Japan. But South Korea has spent more on defense than North Korea every year since 1976 and now has a modern and powerful military capable of defending the country even without U.S. support. Japan is no military weakling either: its Self-Defense Force is supported by the second-largest military budget in the world.

The IAEA has also singled out North Korea for special treatment, confining its inspections in other countries to sites designated as nuclear facilities. Only in the case of North Korea have officials demanded the right to "special inspections" of sites chosen by the IAEA itself.

North Korea may have violated the NPT by resisting such demands, but so has the United States. A central tenet of the treaty, which allows the five formally declared nuclear powers (China, England, France, Russia, and the United States) to keep their weapons while for-

bidding all others from acquiring them, is that a nuclear power may not threaten a non-nuclear power with nuclear attack. But that is exactly what the United States repeatedly has done to North Korea. The Team Spirit war games, begun in 1976 and among the largest in the world, included simulated nuclear attacks on North Korea throughout the 1980s and as recently as 1993.

U.S. policy toward North Korea can best be understood as an outgrowth of distorted relations that have changed little since 1953, when Korean War fighting stopped. In fact, the U.S. still refuses to sign a peace treaty with North Korea officially ending that war, and refuses even to recognize North Korea.

At the Geneva Conference on Korea convened in 1954 to promote peaceful reunification, the North proposed a simultaneous and proportional pullout of all foreign troops, followed by elections under the authority of a Neutral Nations Supervisory Commission. Both the United States and South Korea rejected the proposal, the former calling instead for elections to be held only in the North, according to Southern laws and procedures and under the supervision of the United Nations, which had been a participant in the war. Most foreign observers at the conference concluded that the United States was not serious about negotiating peace. Sadly, little has changed. The U.S. government still seeks victory over the North.

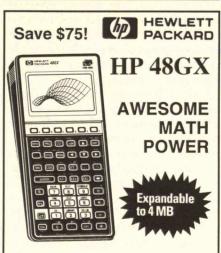
The connection between this war mentality and the present nuclear controversy is direct. Although the United States criticizes North Korea for its reckless nuclear ambitions, it was the United States that first threatened North Korea with nuclear destruction during the Korean War. And it was the United States that first introduced nuclear weapons to the Korean peninsula in 1957, stationing them in South Korea in direct violation of the armistice. It is not so much North Korean recklessness as U.S. hostility that is pushing us toward a a new Korean conflict.

If the U.S. government is seriously committed to advancing the cause of

peace in Northeast Asia, it must come to terms with the legacy of the Korean War. Signing a treaty formally ending the war, forgoing Team Spirit war games, and establishing diplomatic relations with North Korea are essential steps.

By adopting a more rational and responsible foreign policy toward North Korea, we will not only decrease the likelihood of a new Korean War but also foster an environment in which the Korean people can more effectively work for the peaceful and democratic reunification of their country.

MARTIN HART-LANDSBERG is a professor of economics at Lewis and Clark College. He has served as a consultant to the Korea program of the American Friends Service Committee and is the author of The Rush to Development: Economic Change and Political Struggle in South Korea (Monthly Review Press, 1993).



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Reviews

BOOKS

TRUTH OR TATEMAE

Japanophobia: The Myth of the Invincible Japanese by Bill Emmott Times Books (Random House), \$25

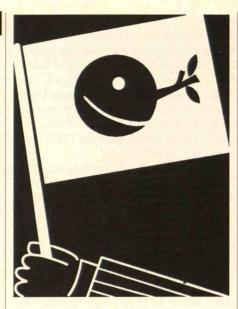
BY ROBERT J. CRAWFORD

In the 1980s, Japanese corporations went on a multibillion-dollar binge, building state-of-the-art chip factories and gobbling up American icons such as the Rockefeller Center along with countless high-tech start-ups. To "business intellectuals" in the West, who had long extolled the prescience of Japan's technocrats and the almost mystical virtues of its managers, Japan was claiming its rightful role as global leader. The few dissenting voices pleaded for trade barriers before it was too late to "save" U.S. manufacturing industries.

Today, however, American firms have mastered many of Japan's manufacturing techniques and are reclaiming the initiative in automobiles, computers, and communications. As Japan struggles to reform a troubled political system during its worst recession since World War II, it is time to reassess the Japanese "economic juggernaut." How could Japan stall so quickly? What hidden weaknesses, if any, does its plight reveal? Will a leaner Japan come roaring back, stronger than ever? Or were U.S. fears and insecurities exaggerated all along?

In Japanophobia, Bill Emmott, editor of The Economist, attempts to answer these questions from a macroeconomic perspective. The story begins in the mid-1980s, with the excesses of the "bubble economy." This era of dirt-cheap money—created by trade-surplus cash, unusually low interest rates, and a one-time deregulation of banking—fueled an orgy of self-reinforcing speculation.

As easy money chased the limited supply of property, Emmott writes, real



estate values skyrocketed. Japanese consumers, feeling wealthy for perhaps the first time, borrowed and spent more. Japanese corporations, investing to meet rising consumer demand, could leverage their debts against their many properties. The same logic held for the stock market, which generated ever greater profits: new investments enhanced the cycle, promising an ever more productive future.

Those were heady days in Japan, and few paused to ponder whether the bubble could burst. Emmott writes that a "sense of hubris and overconfidence" permeated Japanese banks and corporations. Meanwhile, the boom accelerated beyond any rational proportion. The cash value of the imperial palace grounds in central Tokyo, for example, at one time rivaled that of the entire real estate market in California. Eight-hundred-dollar meals, supported by bulging corporate coffers, became commonplace in many firms.

Debts were based on an assumption of increased wealth tomorrow. But once stock prices peaked in 1990, the system slowly shifted into reverse, sucking the entire economy into a downward spiral. Unfortunately, just as corporate borrowing bills came due, many of the 1980s investments turned sour. The illusion of cheap capital had encouraged Japanese corporations to build plants that even

under the most optimistic market forecasts would be difficult to utilize fully. Japanese car makers, for example, now operate at 20 percent below capacity, a tremendous financial burden that could take them decades to overcome; in an ironic role reversal, they are looking to Detroit for lessons in "successful downsizing." Consumer electronics firms and chip manufacturers also suffer from idle plants.

Following Sony's lead with Columbia Pictures, Matsushita acquired the entertainment giant MCA for \$6 billion, a price that industry analysts agree was grossly inflated. Emmott dubs these dubious investments, based on the vague promise of "merging" Japanese hardware expertise with American software, the "great Hollywood mugging." The electronics firms, Emmott claims, in effect became bankers to a profligate and self-indulgent industry.

Despite the excesses of the bubble economy, Emmott argues, Japan continues to follow a "brilliant middle" strategy: excelling in VCRs, automobiles, and memory chips but not in high-value-added markets like pharmaceuticals, jet airliners, and microprocessors; and educating its people to be above-average middle managers and product assemblers but not leaders or world-class specialists. In other words, Emmott concludes, Japan is a capable though modest follower—hardly the formidable threat that the advocates of trade barriers claim it to be.

Stones Left Unturned

Emmott succeeds in placing Japan's economic strengths in context, but when he attempts to predict the future, his analysis begins to unravel. Despite today's debilitating recession, Emmott believes, Japan's "consensus-based" society, its "superior" manufacturing techniques, and its drive for "continuous product improvement" (or *kaizen*) will allow it to rise again, perhaps to a more sober leadership role. Yet because he fails to probe beneath these stereotypes, he illuminates very little about the "myths" of Japanese invincibility—the hidden

weaknesses that threaten to destabilize the economy and perhaps worse.

The current recession, as Emmott points out, is slowly forcing Japanese firms to restructure. What he doesn't say is that plant closings and lavoffs could remove a pillar of the social contract in Japan, the much ballyhooed "lifetime employment" system. In exchange for job security, Japan's mostly male white-collar employees—the salariman—have sacrificed their lives for their firms, observing for years the meaningless corporate obligations imposed on them by arrogant bosses; because their working days often extend into mandatory late-night drinking with colleagues, many men scarcely know their children. Should the right to a job be sacrificed to economic efficiency, the rage of the salariman could reach explosive levels. (Outbreaks of mass violence, such as rail commuters smashing train stations during rush hour strikes, have gone largely unreported in the West.)

Perhaps even worse, an ever-widening series of political scandals is alienating the Japanese public from the political elite. The resignation of Prime Minister Morihiro Hosokawa in April—amid accusations that he had accepted a \$1 million interest-free loan from a trucking firm tied to the Japanese underworld, or Yakuza—was only the tip of the iceberg. Money runners for Japanese construction companies, for example, have been caught with actual shopping carts full of cash to bribe politicians. Yet the anger and disgust of the Japanese have also gone largely unreported.

Why aren't these problems better known? Why have observers overestimated and romanticized Japan to such absurd lengths? In part, the answer to these questions—which Emmott fails to address—lies in Japanese culture.

The custom known as *tatemae* obliges the Japanese to paint a rosy picture of life in their country, a kind of cultural public relations façade. Official information is carefully slanted to maintain appearances. By narrowing its definition to institutionalized cases, for example, the Ministry of Health has claimed that there are only 20,000 alcoholics in

Japan. The Japanese are not liars; most assume that all cultures strive to save face in the same way. But the custom allows them to veil the truth in ways that foreigners find difficult to penetrate.

Many old-guard Japanologists like James Abegglan, of Sophia University in Tokyo, and Robert Christopher, best-selling author of The Japanese Mind, have presented tatemae verbatim to Americans as a reality to be emulated, creating a series of "Japanese management" myths. For example, "bottom-up decision making" and "consensus building," which Emmott praises as keys to Japan's manufacturing success, are in fact empty rituals designed to create the appearance of concern and involvement; foreign employees who take the rhetoric of their bosses seriously enough to make suggestions are scoffed at as hopelessly naive. The persistent myth that Japanese firms somehow serve as extended families is tatemae at its most idiotic—the reality is closer to a dysfunctional family, in which the appearance of harmony (or wa) is maintained no matter what the personal cost.

Foreign reporters have fared little better than scholars. When journalists ask leading questions, Japanese officials are happy to supply them with syrupy doses of tatemae simply by answering "yes." To extract the real story, investigators must become trusted drinking partners of their subjects, but even then reporters often lack the time to pursue the bigger picture; it is far easier to choose some small detail and build a story around it. incorporating a strong measure of tatemae. T.R. Reid, the Washington Post's bureau chief in Tokyo, has started a second career as a tatemae promoter on National Public Radio, His tales about the delights of everyday Japanese life—like the intelligence of the country's comic books (which are mostly mindless, and often sadomasochistic or pornographic) or the convenience of Tokyo's indoor ski slopes (poor substitutes for the real thing that are mobbed by angry, impatient skiers)—misinform the public and irritate foreigners like me who have lived in Japan.

Those who disagree with the tradi-

tional Japanologists, the so-called revisionists like the Dutch reporter Karel Van Wolferin or Clyde Prestowitz, once a trade negotiator in the Reagan administration, have often seen their unflattering critiques dismissed as racist or lost in the glare of the bubble economy. Perhaps a deeper reason the myths endure, which Japan's current downturn may demolish, is America's need to believe in "progress," if not at home then somewhere else. For better or worse, Japan has become a mirror for the United States: we don't *want* to debunk the hype that has surrounded Japan for decades.

Emmott's book provides some longneeded perspective to the debate about Japan. Unfortunately, by failing to question the myths it purports to expose, Japanophobia in the end becomes a flaccid paean to free trade. An earlier, more penetrating Emmott work, The Sun Also Sets, received the applause it deserved. But for presenting just half the picture, this one merits only the sound of one hand clapping.

ROBERT J. CRAWFORD, assistant director of the Office for Sponsored Research at Harvard University, has been a policy analyst at the National Science Foundation's Tokyo office and a columnist for the Far Eastern Economic Review.

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BOOKS

EXTENDED FAMILY

The Fourth Discontinuity: The Co-Evolution of Humans and Machines by Bruce Mazlish Yale University Press, \$30

BY WILL WARNER

ESTERN science is curiously Eastern in its quest for unity. Beginning with analysis and moving to synthesis, science seeks ultimately to portray all things as manifestations of one underlying reality. When unity is not apparent, we speak of "discontinuities" in our understanding of the world, and work to bridge them. These efforts, when successful, become the predominant milestones in the history of science.

Bruce Mazlish, a science historian at MIT, believes that one surviving discontinuity is ready for elimination. In *The Fourth Discontinuity*, Mazlish maintains that the sharp distinction between human beings and machines is the last of four discontinuities arising out of our species' penchant for seeing itself as a thing apart. This last discontinuity now proves artificial and unnecessary, as did the other three.

Pre-Copernican cosmology set the heavens apart from the earth, the perfect from the corporeal, while at the same time locating human beings on the bull's-eye of the universe. But cosmology since Copernicus grants no "heavens," no division of the eternal from the mortal; physical laws are the same everywhere, and humans cling to a small rock, nowhere special.

Darwin's theories placed humans on a continuum with other living things, and thus removed the need to assume a special creation just for us. After Darwin, the undeniable animal physiology of the human body is no longer an odd coincidence but compelling reason to recognize ourselves as animals.



Freud deprived us of our station as "the rational ones." Rationality may be only a thin veneer on a largely irrational and reflexive subconscious that controls us more than we know.

Mazlish seeks to end the fourth discontinuity by adding machines to the animal-human continuum. While our connection to animals is biological evolution, the connection to machines is more difficult to explain. One tack that Mazlish takes is this: people are animals, animals are machines, ergo people are machines.

In the eighteenth and nineteenth centuries, the founders of modern biology and medicine demonstrated that animal (including human) physiology is electrochemical—that is, mechanical. This process of discovery continues today as genetic research deciphers page after page of the blueprint of life. Nevertheless, people continue to experience free will and to sense that life, especially human life, is more than a game of billiards played with atoms. The question goes unresolved.

But Mazlish also approaches the matter in another way. He argues that the past and future evolution of humans and the "evolution" of machines are so intertwined that the line between us begins to blur. "When humans first appear, they are already holding tools," the author writes. "Our fossil remains are of human and tool together." Tools enabled us to trade away strength and speed, as well as auditory, olfactory and visual acuity, for brain power. With tools we could be weak and slow and still survive. Evolution, then, made us an animal that relies on tools—and now machines—to survive.

"Generations" of machines have resulted from our selection of features that best served our needs as beings engaged in the evolutionary contest. The same inexorable forces that have made us—the forces that unconsciously guide life in the direction of greater "fitness"—have indirectly made what we make, namely machines. That realization supplies the continuity: machines are just a further manifestation, another product, of evolution.

Fellow Travelers

Machines have evolved from us in the sense that they would not have existed without us. But Mazlish is more comfortable portraving our joint emergence as coevolution, analogous to the human relationship with farm animals. In a book called The Covenant of the Wild: Why Animals Chose Domestication, science journalist Stephen Budiansky shows how the "domestication of animals is a natural product of evolution" because it enhances the fitness of both the farmer and the livestock. They are driven into each other's arms by nature, "a force larger than themselves, with its own rhythms, its own purpose, its own sense of morality." Nature's tides bear us both along together, each accommodating the other, each suffering the atrophy of certain traits in favor of others, and all of it, from a biological point of view, to our mutual advantage.

So it is with machines: we have come along together. But just as with domesticated animals, our use of them affects us as well. We become more "mechanical in hand, heart, and head," and it

REVIEWS

shows in the way societies are structured. The branches of a modern democracy are counterweights in a system designed to be a self-regulating balance of powers. An economy is merely organized effort in pursuit of continued survival (and, when time permits, security and comfort). Time clocks, assembly lines, train schedules, and the like regiment our lives. We submit to this order in the name of "efficiency" because we know that, up to a point, the more efficient our life is, the more life we have. We also admire machines for their power and durability, and especially their unerring ways, so we don't mind being a little more like them.

In a very real sense, our machines are extensions of ourselves, prostheses upon which we've come to depend, and Mazlish predicts that the intimacy between humans and machines will only deepen. Genetic engineering, dramatically displayed in the patenting of new organisms, is leading to the "mechanization of animals," providing further proof of life's mechanistic nature. At the same time, improvements in artificial intelligence are bringing about the "animalization of machines." As our use of machines—especially computers-intensifies, Mazlish writes, "something like a new species will eventually emerge," perhaps one in which humans routinely don or surgically implant mechanical parts.

The book's dedication is to Jacob Bronowski, the scientist and author of *The Ascent of Man* who quit physics for biology in despair over atomic weapons. Writing about the bomb, but also about technology in general, Bronowski asked on behalf of all of us the musical question, "Is you is or is you ain't ma baby?" By "baby," of course, he meant nothing more than "creation," as in Frankenstein's monster. But if the fourth discontinuity is truly closed, Bronowski's choice of words was more apt than

he knew.

WILL WARNER, a computer engineer, communes with machines in Ann Arbor, Mich.

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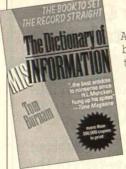
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important information servers (archie, wais, gopher) that are, essentially, databases of databases. There's also coverage of the World-Wide Web, including the Web's multimedia browser, Mosaic. So if you use the Internet for work or pleasure—or would like to—you need this book!

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LETTERS

CONTINUED FROM PAGE 9

SMART SIGNS AND SIGNALS

In "Outsmarting Traffic Jams" (TR February/March 1994), Thomas Krawczyk writes about using on-board computers to help drivers avoid traffic jams. But what we need instead are computer-controlled "smart intersections" that prevent bottlenecks by allowing the maximum number of vehicles through. How many hours a year does the average commuter idle at red traffic lights when there is little or no cross traffic?

THOMAS SIMON Lakeville, Minn.

In 1979 I observed an effective trafficcontrol system in Goettingen, Germany. Recommended speeds were posted that rapidly varied with time of day and traffic signals ahead. By observing the speed recommendations, I was able to proceed almost unhindered by traffic or lights throughout most of the city. This seems far simpler than, or a supplement to, the idea of a computer in each vehicle.

HARRY B. DITMORE Rupert, Idaho

Thomas Krawczyk claims that intelligent vehicle highway systems (IVHS) could reduce commuter automobile travel time by 10 percent. But at what cost? The new technology is modeled on the old disproven waste-disposal axiom that "dilution is the solution to pollution." Improved mobility for automobile users would be accomplished by spreading traffic out on more roads. But what IVHS actually promises is a short-term increase in traffic volume at a high social cost. As every highway planner has observed, the more highway capacity we provide, the more cars fill the space.

If resources spent on IVHS technology were redirected to mass transit, the world would benefit through improved transportation choice, land preservation, cleaner air, more efficient use of resources, solid-waste reduction, saved time, and yes, even improved mobility at less cost. The best way to "outsmart traffic jams" is to eliminate automobiles. The most beneficial way to achieve this

end and create revenue for effective public transit is to impose a 50-cent-per-gallon tax on gasoline. Let's put the cap back on the IVHS bottle before another malevolent genie escapes to accelerate our self-destruction.

HENRY F. ARNOLD Princeton, N.J.

EDUCATIONAL GIFTS

Pity the poor gifted students. In "How Schools Are Shortchanging the Gifted" (*TR April 1994*), Sally Reis seems to think that they are the only children who are bored in school, the only ones who suffer



from poorly prepared teachers, the only ones who could profit from richer, more active, more adaptive curriculum. Reis seems to have a romantic view of how wonderful school must

be for below-average students who love those textbooks dumbed down just for them.

There is indeed a crisis in the education of the gifted, but it is a crisis shared equally by all American students. The enemy is not attempts to eliminate tracking of students by ability; the enemy is boring, repetitive, passive instruction that fails to engage the intelligence, energy, and enthusiasm of all students. Reis notes that fifth graders in Taiwan and Japan study algebra, and that the Dutch complete multiplication and division in third grade. None of these countries uses any form of ability grouping or separate gifted programs in elementary school. The problem is that we hold low expectations for all our students. Dealing with this problem by separating out gifted students is like moving them to the top deck of the Titanic.

Reis's disparaging comments about cooperative learning also confuses two issues. It is heterogeneous grouping, not cooperative learning, that worries her; presumably she'd be delighted if cooperative learning were used within a separate gifted program (as it often is). Furthermore, there is evidence that gifted stu-

NUMBER

Classifieds

dents gain from cooperative learning in heterogeneous groups; a recent study by James Gallagher found that they generally loved it. Appropriate forms of cooperative learning that make it impossible for one student to do the group's work can be beneficial for all students.

Actually, I am more a supporter of gifted education than Reis. She would restrict it to perhaps 5 percent of students while I would advocate it for 100 percent. What student wouldn't benefit from more experiments, projects, history fairs, and active, engaging, interactive instruction? There may be a need for acceleration for older students in subjects like mathematics, but let's abandon the idea that simply putting high achievers together will cause sparks to fly and miracles to happen. What matters is quality of instruction for all.

ROBERT SLAVIN Center for Research on Effective Schooling Johns Hopkins University

EXISTENTIAL PLEASURES OF CYBERSPACE

In "Odysseus in Cyberspace" (TR April 1994), Samuel C. Florman seems unable to see analogies between old and new technologies. Because of the ease with which one can explore distracting new interests, Florman fears that "flights through cyberspace...may weaken the objective rationality needed to do good engineering." Perhaps Florman has never had the experience of researching a subject in the library and discovering books on interesting but unrelated topics. The quality of information available should not affect the discipline needed to focus on a problem, and ignorance of new ideas will not improve the quality of engineering.

Florman also ignores the fact that one of the information resources in cyberspace is people who share similar interests—discussion is one of the best ways to refine engineering ideas. Florman began the column by stating that he did not use electronic mail: perhaps if he explores the new technologies available, he will come to a different conclusion.

STEPHEN P. BERCZUK Arlington, Mass.

You're Boxed In

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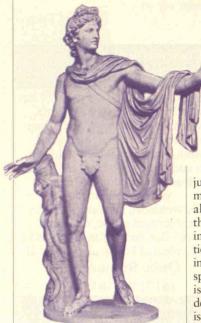
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Phenomena

By DAVID BRITTAN



THE HIGH ART OF APOLLO XI

Twenty-five years ago to the month, my family gathered around a black-and-white Admiral TV set to watch a man in a spacesuit make history. The images of Neil Armstrong's descent from the Apollo lunar module were so fuzzy and underexposed that we could have been witnessing a fat caterpillar inching its way down a tree trunk. But I was too giddy to care. The moment I had dreamed about for the better part of my 12 years—the anticipation of which had heightened my interest in science, given me an appetite for all the science-fiction literature I could consume, and even inspired me to lose weight for my future career as an astronautwas now at hand.

Just then, the phone rang. Flo, a friend of my mother's, had picked this moment to call and say hi.

"You know, I really can't talk now," my mother told Flo. "They're about to walk on the moon."

"Oh," Flo replied, "are you watching that? We're watching 'The Flintstones.'"

By this admission, Flo confirmed what I had often suspected: that she, her layabout husband, and her two sad, dull-eyed children were the most primitive people on earth—that they, not the Flintstones, were the modern Stone Age family.

Granted, this was a harsh judgment for a sixth-grader to make about people who probably led hard lives and lacked the advantages of growing up in a family that valued education. But I stand by the underlying premise: an appreciation for space travel and all it embodies is a mark of civilization; the denial of these intangible riches is a kind of Philistinism.

As it happens, the Flo episode was not the first time I made the connection between space and culture. Earlier that year, the Pasadena (Calif.) Star-News selected my sixthgrade class, apparently at random, to be the subject of an article on school kids and their interest in the Apollo project. "Their room is decorated with pictures showing the evolution of the rocket," the reporter wrote. "They talk about the moon the way that youngsters a generation ago talked about Antarctica."

One can, if one is prepared to dip into the microfilm archives of the Pasadena Public Library, read little Gary Tracy's prediction that "in about 25 years the United States will be living on the moon." Beverly McCarter ventured that "with all the space traveling and experiments going on today, in approximately 24 to 50 years, other planets may be inhabited by beings . . . human beings." My own prediction was that by collaborating with other nations in space "we will find ourselves crawling out of our caves and starting the colonization of new worlds."

The phrase "crawling out of our caves" was probably a dig at the teacher, whom I perceived to be a space Philistine of the first order. Mrs. Australopithecus (not her real name) showed no interest whatever in space exploration. All around her-in newspapers, on television, on the playground-excitement over Apollo was mounting, as each mission brought the world a step closer to that day in July 1969 when humans would land on the moon. Yet Mrs. Australophithecus was unmoved. The rocket pictures the reporter mentioned had mysteriously appeared in our classroom the morning of his visit. We had had no class discussions, no science lessons, no essay assignments on space. At one point the teacher had even gone so far as to tear up my drawing of a fanciful spacecraft, declaring curtly, "That's not art!"

This is precisely where she and other space Philistines are wrong. A spaceship is art, and the pathbreaking Apollo XI mission was art of the highest kind. The very names Mercury, Gemini, and Apollo are classical allusions of the sort that have dominated Western art for 2,000 years. The reference to Apollo was especially apt, as the Greek god was identified not only with sunlight but also with law, philosophy, medicine, poetry, and music-the finest achievements of civilization.

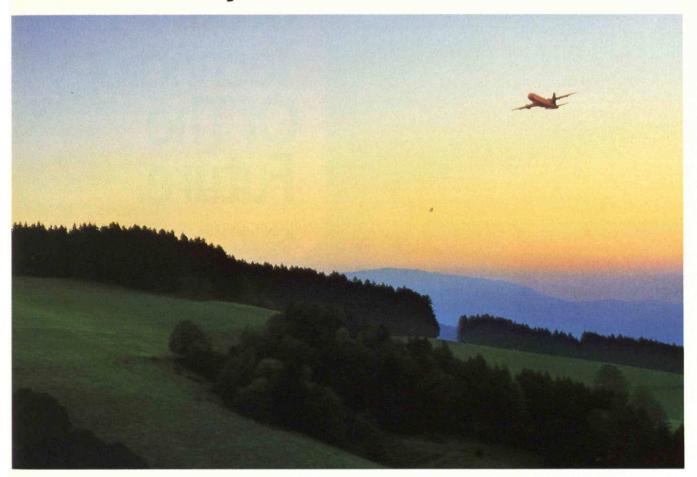
The designers of the U.S. space program proceeded as all great artists do. They began with a daring and improbable vision and, ignoring the high risk of failure, mustered all their intellectual powers to make it happen. The Sistine Chapel ceiling was once bare. Beethoven's Ninth took shape in an empty notebook. When President Kennedy announced, "We choose to go to the moon," the gulf between him and his destination lay stretched out like 240,000 miles of blank canvas.

The gulf bridged by Project Apollo was more than just physical. Like other forms of art, space exploration has the power to speak across cultural and ideological divides. In the midst of the Cold War, Yuri Gagarin's first flight gave Americans a slap in the face, yet they could not hide their admiration and awe. The U.S. space program, launched in earnest by a Democratic president, reached its pinnacle under his Republican archrival. And on July 20, 1969, the impressionistic images from the moon found their way equally into living rooms in Tokyo and coffee houses in Ryadh.

Those who watched on that day were treated to a work of art staged by an immense corps of talented performers. The preparation, the rehearsing, the synchronization of a million deft maneuvers were nothing short of ballet. (See "Fly Me to the Moon: An Interview with Joseph G. Gavin, Jr.," page 61.) And the presence of Neil Armstrong, Buzz Aldrin, and Michael Collins, sympathetic but fallible human actors who at any moment could flub a line or miss a cue, gave Apollo XI an element of drama rarely seen outside of live theater.

Art is about everything human beings do best. So is space. The inspiration, organization, courage, and technical skill embodied in both of these realms are a monument to all that we have learned over several million years of living. Unfortunately, artists and astronauts lead a similarly precarious existence. This is because the true value of what they do is difficult to measure in dollars. The more the U.S. space progam is called to account for itself in terms of commercial payoff, the more its fate will come to resemble that of arts funding in the public schools. After all, the reasoning might go, if Johnny and Susie can do without violin lessons, they can certainly do without a human mission to Mars. And indeed they can. It's just that the world they inherit will begin to look a lot like Bedrock.

We believe they should be seen and not heard.



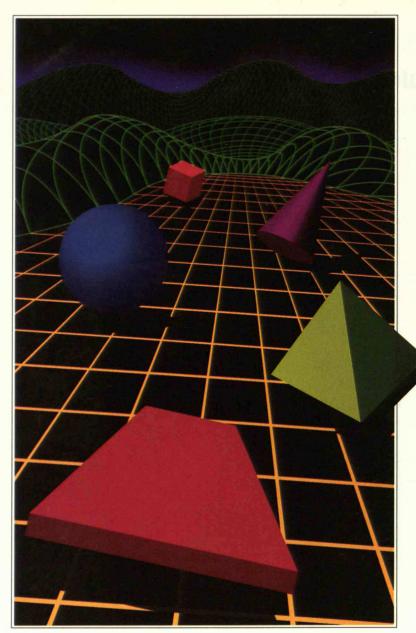
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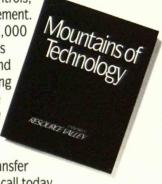
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